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RADIATION DATA AND REPORTS

Volume 14, Number 7, July 1973

Radiation Data and Reports, a monthly publication of the Environmental Protection Agency presents data and reports provided by Federal, State, and foreign governmental agencies, and other cooperating organizations. Pertinent original data and interpretive manuscripts are invited from investigators.

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. This responsibility was delegated to the Bureau of Radiological Health, Public Health Service. Pursuant to the Reorganization Plan No. 3 of 1970, effective December 2, 1970, this responsibility was transferred to the Radiation Office of the Environmental Protection Agency which was established by this reorganization.

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Published under the direction of

Dr. W. D. Rowe
Deputy Assistant Administrator
for Radiation Programs

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Address correspondence to the Editor, *Radiation Data and Reports*, Office of Radiation Program, Waterside Mall, E615, Washington, D.C. 20460.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
Robert W. Fri, Acting Administrator

SYNOPSES

Synopses of reports, incorporating a list of key words, are furnished below in reference card format for the convenience of readers who may wish to clip them for their files.

RESULTS OF A SURVEY OF DIAGNOSTIC AND THERAPEUTIC X-RAY MACHINES, SUFFOLK COUNTY, NEW YORK, 1972. *Seymour Becker. Radiation Data and Reports*, Vol. 14, July 1973, pp. 397–400.

An investigation was conducted in Suffolk County, N.Y. to determine the number of diagnostic and therapeutic x-ray machines that were in violation of the New York State Ionizing Radiation Regulation. An x-radiation inspection in 1962 had found that approximately 75 percent did not comply. The followup survey in 1972 found that about 37 percent did not comply. This demonstrates that with careful supervision by a local health unit and cooperation by the professional practitioners, progress can be made to reduce the x-radiation exposure to the public.

KEYWORDS: Dental x ray, medical x ray, therapeutic x ray, Suffolk County, N.Y.

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Results of a Survey of Diagnostic and Therapeutic X-ray Machines, Suffolk County, New York, 1972

Seymour Becker[1]

An investigation was conducted in Suffolk County, N.Y., to determine the number of diagnostic and therapeutic x-ray machines that were in violation of the New York State Ionizing Radiation Regulation. An x-radiation inspection in 1962 had found that approximately 75 percent did not comply. The follow up survey in 1972 found that about 34 percent did not comply. This demonstrates that with careful supervision by a local health unit and cooperation by the professional practitioners, progress can be made to reduce the x-radiation exposure to the public.

In 1962, the Suffolk County Health Department established a full time Radiation Control Unit to implement the requirements of the ionizing radiation section of the New York State Sanitary code, Statutory Authority: Public Health Law 225.

The Radiation Control Unit is responsible for the evaluation and control of x-radiation-producing equipment that may be a health hazard to the public. The code requires that owners of diagnostic and therapeutic x-ray machines register their equipment with the Suffolk County Health Department; also, that the Department shall inspect the apparatus for full compliance with the New York State regulations.

Although intensive effort has been made periodically by the department to publicize the radiation control program, approximately 80 percent of those x-ray machines registered were located through a time-consuming procedure of letter writing, telephone calls, and checking the telephone directory. Many of the owners of the x-ray units claimed ignorance of the registration requirement or were indifferent to the program. Therefore, a number of x-ray machines are being installed or are in use without the department's knowledge. Eventually, over a period of time, possibly years, these machines will be located by representatives of the Radiation Control Unit.

Daily, many people in Suffolk County who visit a physician, dentist, chiropractor, podiatrist, osteopath, dermatologist, or hospital, are being x-rayed when prescribed by the professional practitioners. The public appears to be confident that the x-ray equipment when energized will not create a health hazard and that the operator is licensed where required.

Our survey has shown, however, that many owners and operators of the apparatus do not know if the x-ray machine is functioning according to regulatory requirements. Consequently, the patient, the doctor's office staff, and the operator often are unsuspectingly being exposed to unwanted radiation.

During routine inspections of x-ray machines, the most common examples of needless radiation exposure were found to be attributed to (a) lack of training or inadequate training of the operators, (b) noncomplying x-ray machines, (c) inadequate protective shielding for the operators, and (d) lack of concern of the operators for good x-ray protection procedures.

Some outstanding examples of needless exposure that were observed or reported during announced or unannounced visits to x-ray facilities are:

(a) Where fixed cones are used, some operators do not interchange the multiple cones to reduce the x-ray beam to the area of clinical interest. In several instances, the cones are available for the announced inspection, but on unannounced visits improper oversized cones or none at all were used during x-ray examinations.

---

[1] Mr. Becker is chief, Radiation Control Unit, Division of Environmental Health, Suffolk County Department of Health, Smithtown, N.Y.

(b) Where a manual variable collimator is used with a light localizer attached, some operators do not adjust the collimating device to reduce the x-ray beam to the area of relative dimensions of the film.

(c) Dental assistants have reported that some dentists remove the dental collimator after the inspection. The reason given is that to position the x-ray tube head accurately before taking the x ray is time consuming.

(d) Some dentists who operate conventional x-ray machines use the same x-ray unit for cephalometric x-ray examinations. The techniques used for cephalometric x-ray diagnosis require a larger x-ray beam at a greater distance. The operator unknowingly uses the same collimating device for both the conventional and cephalometric examination.

(e) Many x-ray machines inspected had inadequate filtration or no added filtration at the tube port. In some instances, when an x-ray tube head is returned after servicing, the filters were missing.

(f) Many fluoroscopic x-ray machines had inadequate shutters. The x-ray beam was emitting beyond the fluoroscopic screen. Where x-ray units were converted to use image intensifiers, the shutters were not properly adjusted to the input phosphor of the device.

(g) Some fluoroscopic equipment had malfunctioning timers. Therefore, the fluoroscopist was not aware of the length of time spent during fluoroscopy. Old equipment was sold and resold with the faulty component.

(h) Fluoroscopic x-ray rooms were not darkened adequately; therefore, the light in the room interfered with the fluoroscopic examination. To compensate, the milliamperage would have to be increased producing more x rays.

(i) Some operators permit an assistant to hold a patient during an x-ray examination. In some instances, the same person is required to hold the patient for each x ray taken without wearing protective shielding.

Tables 1 through 6 contain the findings of a survey that was conducted during 1972 in Suffolk County, N.Y., to determine the number of diagnostic and therapeutic x-ray machines used in hospitals, medical, dental, chiropractic, and podiatric x-ray facilities that were not in full compliance with Part 16, Ionizing Radiation of the New York State Sanitary Code.

Table 1. Results of x-ray machine inspections Suffolk County, N.Y., 1972

Results and types of violations	Total
X-ray machines inspected [a]	1,411
X-ray machines in violation [b]	479
X-ray machines corrected [c]	368
Types of violations:	
Inadequate collimation	260
Inadequate filtration	183
Operator cannot stand 6 feet away (dental, medical, portable)	76
Inadequate protective shielding for operator	45
Inadequate shutters (fluoroscope)	32
Inadequate timer (fluoroscope)	35
Control used by operator outside a shielded area	24
Light leaks (fluoroscope)	14
Unlicensed x-ray technician (medical, dental, cephalometric)	18
Inadequate apron and gloves (fluoroscope)	9
Inadequate operating procedures	8

[a] Thirty-four percent of the x-ray machines did not comply fully with Part 16, Ionizing Radiation of the New York State Sanitary Code.

[b] Seventy-seven percent of those x-ray machines in violation are presently in full compliance of the Code.

[c] Some x-ray machines inspected had multiple violations.

When the Radiation Control Program started in 1962, approximately 75 percent of the x-ray machines surveyed did not meet the code requirements. The 1972 survey shows that only 34 percent do not comply. This demonstrates that with careful supervision and cooperation by the professional practitioners, progress can be made to reduce the radiation exposure to the public.

To further meet that goal, the following radiation protective measures are recommended:

(a) Each owner or operator of an x-ray machine should be required to obtain and display a certificate indicating that his competence in radiation protection is certified. This certificate should also extend to the inspectors of the x-ray equipment.

(b) No x-ray equipment should be installed unless the owner shows evidence of certification.

(c) Plans for new or relocated x-ray facilities should be reviewed by a regulatory agency.

Table 2. Results of x-ray surveys in hospitals (diagnostic and therapeutic x-ray machines)

Results and types of violations	Type of x-ray unit: Radiographic	Dental	Fluoroscopic	Photofluoroscopic	Combination radiographic and fluoroscopic	Therapy	Portable	Total
X-ray machines inspected	31	6	1	1	29	7	24	99
X-ray machines in violation[a]	18	2	1	1	22	3	15	62
X-ray machines corrected[b]	12	2	1	1	17	2	14	49
Types of violations:[c]								
Inadequate filtration	7	2			1		8	18
Inadequate collimation	9	1					5	15
Inadequate shielding	8			1	1	2		12
Inadequate reset timer			1		12			13
Inadequate shutters					9			9
Cable (attached to the exposure switch) less than 6 feet from the x-ray machine		1					7	8
Control operable outside a shielded area	1				4			5
Light leaks					5			5
Inadequate operating procedures	1						1	2
Inadequate interlock						1		1

[a] Sixty-three percent of the x-ray machines did not comply fully with Part 16, Ionizing Radiation of the New York State Sanitary Code.
[b] Seventy-nine percent of those x-ray machines in violation are presently in full compliance of the Code.
[c] Some of the x-ray machines inspected had multiple violations.

Table 3. Results of medical x-ray machine surveys (diagnostic and therapeutic)

Results and types of violations	Type of x-ray unit: Radiographic	Fluoroscopic	Combination radiographic and fluoroscopic	Therapy	Portable	Total
X-ray machines inspected						193
X-ray machines in violation[a]						98
X-ray machines corrected[b]						55
Types of violations:[c]						
Inadequate collimation	25		25	1		51
Inadequate filtration	13	4	15			32
Inadequate shielding	14		11			25
Inadequate shutters		7	16			23
Inadequate reset timer		3	19			22
Control used by operator outside a shielded area	10		7			17
Light leaks		2	7			9
Inadequate operating procedures			2	1		3
Inadequate apron and gloves		2	1			3
Unlicensed x-ray technician	3					3
Tube to panel distance less than 12 inches		1				1
Personnel monitoring required			1			1

[a] Fifty-one percent of the x-ray machines did not comply fully with Part 16, Ionizing Radiation of the New York State Sanitary Code.
[b] Fifty-six percent of those x-ray machines in violation are presently in full compliance of the Code.
[c] Some of the x-ray machines inspected had multiple violations.

(d) X-ray machines should be registered with a regulatory agency.

(e) New or relocated x-ray machines should be inspected prior to use.

(f) Operation of x-ray machines should be temporarily suspended until violations are corrected and reinspected. If this causes a hardship to the operator (no other unit available in an emergency), then limited use should be permitted and a time scheduled for corrective action.

(g) Routine inspections and calibrations of x-ray machines should be conducted by certified radiation specialists.

(h) Regulatory agencies should issue a compliance certificate to be posted in the x-ray facility.

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Table 4. Results of dental x-ray machine surveys

Results and types of violations	Total
X-ray machines inspected	1,003
X-ray machines in violation [a]	250
X-ray machines corrected [b]	235
Types of violations, conventional x-ray machines: [c]	
Inadequate filtration	115
Inadequate collimation	82
Cable (attached to the exposure switch) less than 6 feet from the x-ray machine	65
Types of violations, cephalometric x-ray machines: [d]	
Inadequate collimation (32 out of 40 cephalometric x-ray machines did not have adequate collimation)	32
Unlicensed x-ray technicians	15

[a] Twenty-five percent of the x-ray machines did not comply fully with Part 16, Ionizing Radiation, of the New York State Sanitary Code.

[b] Ninety-four percent of those x-ray machines in violation are presently in full compliance of the Code.

[c] Some of the x-ray machines inspected had multiple violations.

[d] Some dentists who operate conventional x-ray machines use the same x-ray unit for cephalometric x-ray examinations. The technique used for cephalometric x-ray diagnosis requires a larger x-ray beam at a greater distance. The dentist unknowingly uses the same collimating device for both the conventional and cephalometric examinations.

Table 5. Results of chiropractic x-ray machine surveys

Results and types of violations	Total
X-ray machines inspected	54
X-ray machines in violation [a]	37
X-ray machines corrected [b]	23
Types of violations: [c]	
Inadequate collimation	37
Inadequate shielding	8
Inadequate filtration	5
Control used by operator outside a shielded area	2

[a] Sixty-nine percent of the x-ray machines did not comply fully with Part 16, Ionizing Radiation, of the New York State Sanitary Code.

[b] Sixty-two percent of those x-ray machines in violation are presently in full compliance with the code.

[c] Some of the x-ray machines inspected had multiple violations.

Table 6. Results of podiatry x-ray machine surveys

Results and types of violations	Total
X-ray machines inspected	62
X-ray machines in violation [a]	49
X-ray machines corrected [b]	38
Types of violations: [c]	
Inadequate collimation	43
Inadequate filtration	13
Cable (attached to the exposure switch) less than 6 feet from the x-ray machine	3
Unlicensed x-ray technician	2

[a] Seventy-nine percent of the x-ray machines did not comply fully with Part 16, Ionizing Radiation of the New York State Sanitary Code.

[b] Seventy-eight percent of those x-ray machines in violation presently are in full compliance of the code.

[c] Some of the x-ray machines inspected had multiple violations.

In summary, there is a need for an x-ray inspection program enforced by a regulatory agency. Also, radiation doses administered to the public each day could be reduced considerably with no decrease in the number of x-rays or the amount of diagnostic information, if properly trained and licensed operators would use fast film, maintain up-to-date techniques, and routinely have their x-ray machines inspected. Most important, the public must be instructed to demand that the x-ray machines and operators comply with the radiation protection rules and regulations.

Data

SECTION I. MILK AND FOOD

Milk Surveillance, March 1973

Although milk is only one of the sources of dietary intake of environmental radioactivity, it is the food item that is most useful as an indicator of the general population's intake of radionuclide contaminants resulting from environmental releases. Fresh milk is consumed by a large segment of the population and contains several of the biologically important radionuclides that may be released to the environment from nuclear activities. In addition, milk is produced and consumed on a regular basis, is convenient to handle and analyze, and samples representative of general population consumption can be readily obtained. Therefore, milk sampling networks have been found to be an effective mechanism for obtaining information on current radionuclide concentrations and long-term trends. From such information, public health agencies can determine the need for further investigation or corrective public health action.

The Pasteurized Milk Network (PMN) sponsored by the Office of Radiation Programs, Environmental Protection Agency, and the Office of Food Sanitation, Food and Drug Administration, Public Health Service, consists of 63 sampling stations: 61 located in the United States, one in Puerto Rico, and one in the Canal Zone. Many of the State health departments also conduct local milk surveillance programs which provide more comprehensive coverage within the individual State. Data from 16 of these State networks are reported routinely in *Radiation Data and Reports*. Additional networks for the routine surveillance of radioactivity in milk in the Western Hemisphere and their sponsoring organizations are:

Pan American Milk Sampling Program (Pan American Health Organization and U.S. Environmental Protection Agency)—5 sampling stations

Canadian Milk Network (Radiation Protection Division, Canadian Department of National Health and Welfare)—16 sampling stations.

The sampling locations that make up the networks presently reporting in *Radiation Data and Reports* are shown in figure 1. Based on the similar purpose for these sampling activities, the present format integrates the complementary data that are routinely obtained by these several milk networks.

Radionuclide and element coverage

Considerable experience has established that relatively few of the many radionuclides that are formed as a result of nuclear fission become incorporated in milk (*1*). Most of the possible radiocontaminants are eliminated by the selective metabolism of the cow, which restricts gastrointestinal uptake and secretion into the milk. The five fission-product radionuclides which commonly occur in milk are strontium-89, strontium-90, iodine-131, cesium-137, and barium-140. A sixth radionuclide, potassium-40, occurs naturally in 0.0118 percent (*2*) abundance of the element potassium, resulting in a specific activity for potassium-40 of 830 pCi/g total potassium.

Two stable elements, which are found in milk, calcium and potassium, have been used as a means for assessing the biological behavior of metabolically similar radionuclides (ra-

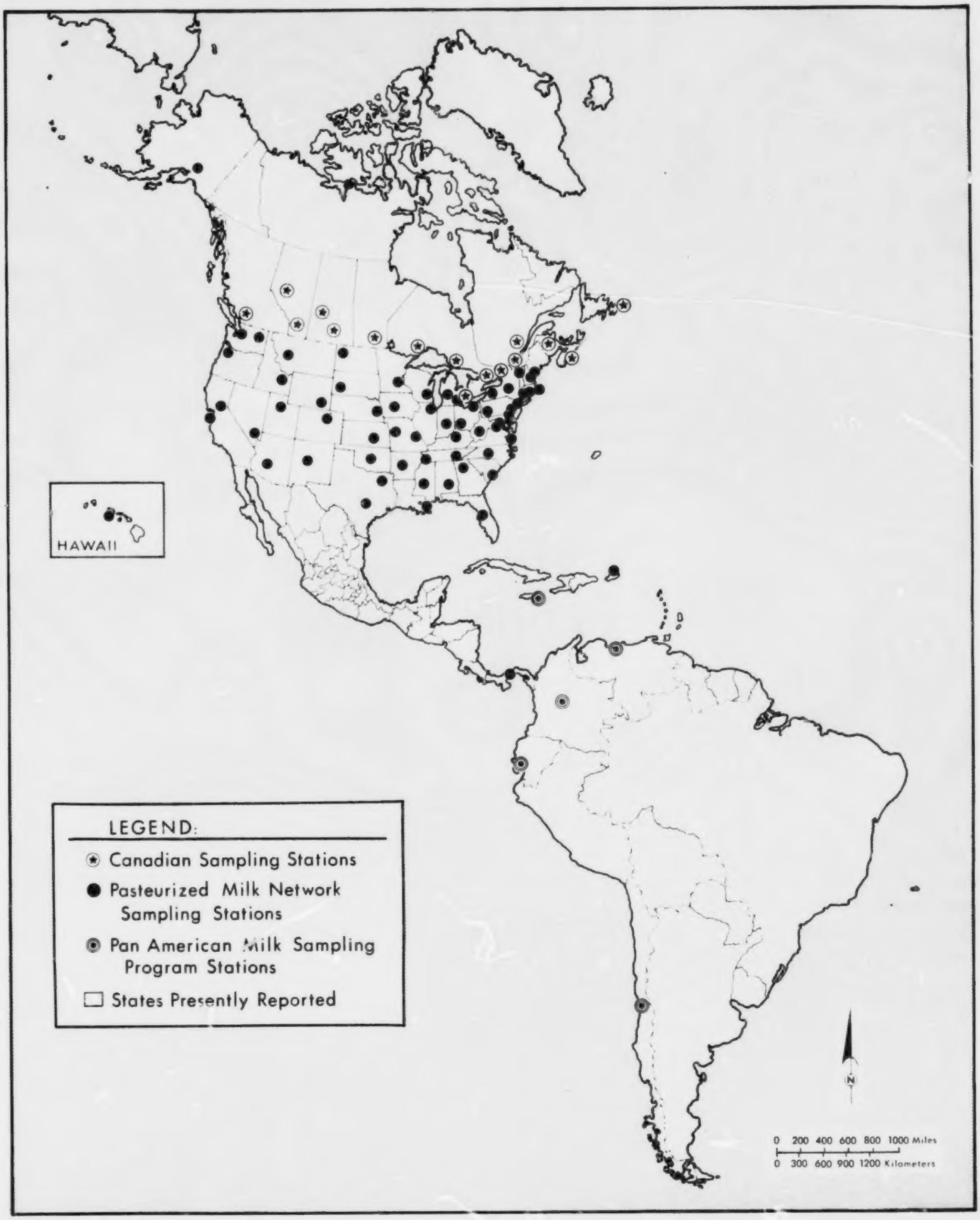
HAWAII
LEGEND:
⊛ Canadian Sampling Stations
● Pasteurized Milk Network Sampling Stations
◉ Pan American Milk Sampling Program Stations
☐ States Presently Reported
N
0 200 400 600 800 1000 Miles
0 300 600 900 1200 Kilometers

Figure 1. Milk sampling networks in the Western Hemisphere

diostrontium and radiocesium, respectively). The contents of both calcium and potassium in milk have been measured extensively and are relatively constant. Appropriate values and their variations, expressed in terms of 2 standard deviations (2σ), for these elements are 1.16 ± 0.08 g/liter for calcium and 1.15 ± 0.21 g/liter for potassium. These figures are averages of data from the PMN for May 1963–March 1966 (*3*) and are used for general radiation calculations.

Accuracy of data from various milk networks

In order to combine data from the international, national, and State networks considered in this report, it was first necessary to determine the accuracy with which each laboratory is making its determinations and the agreement of the measurements among the laboratories. The Analytical Quality Control Service of the Office of Radiation Programs conducts periodic studies to assess the accuracy of determinations of radionuclides in milk performed by interested radiochemical laboratories. The generalized procedure for making such a study has been outlined previously (*4*).

The most recent study was conducted during June 1972 with 37 laboratories participating in an experiment on a milk sample containing known concentrations of iodine-131, cesium-137, strontium-89, and strontium-90 (*5*). Of the 18 laboratories producing data for the network reports in *Radiation Data and Reports,* 14 participated in the study.

The accuracy results of this study for these 14 laboratories are shown in table 1. The accuracy of the cesium-137 measurements continues to be excellent as in previous experiments. However, both the accuracy and precision need to be improved for iodine-131, strontium-89, and strontium-90, which could probably be accomplished through recalibration.

Development of a common reporting basis

Since the various networks collect and analyze samples differently, a complete understanding of several parameters is useful for interpreting the data. Therefore, the various milk surveillance networks that report regularly were surveyed for information on analytical methods, sampling and analysis frequencies, and estimated analytical errors associated with the data.

In general, radiostrontium is collected by an ion-exchange technique and determined by beta-particle counting in low-background detectors, and the gamma-ray emitters (potassium-40, iodine-131, cesium-137, and barium-140) are determined by gamma-ray spectroscopy of whole milk. Each laboratory has its own modifications and refinements of these basic methodologies.

Many networks collect and analyze samples on a monthly basis. Some collect samples more frequently but composite the several samples for one analysis, while others carry out their analyses more often than once a month. Many networks are analyzing composite samples on a quarterly basis for certain nuclides. The frequency of collection and analysis varies not only among the networks but also at different stations within some of the networks. In addition, the frequency of collection and analysis

Table 1. Distribution of mean results, quality control experiment

Isotope and known concentration	Number of laboratories in each category				Experimental 2σ error (pCi/liter)
	Acceptable [a]	Warning level [b]	Unacceptable [c]	Total	
Iodine-131 (96 or 99 pCi/liter)	7 (54%)	1 (8%)	5 (28%)	13	6
Iodine-131 (438 or 484 pCi/liter)	11 (79%)	0	3 (21%)	14	25 or 28
Cesium-137 (53 or 54 pCi/liter)	11 (85%)	1 (8%)	1 (8%)	13	6
Cesium-137 (295 or 303 pCi/liter)	11 (79%)	2 (14%)	1 (7%)	14	17
Strontium-89 (29 or 30 pCi/liter)	10 (83%)	0	2 (17%)	12	6
Strontium-89 (197 or 201 pCi/liter)	4 (40%)	1 (10%)	5 (50%)	10	11 or 12
Strontium-90 (32.1 or 32.4 pCi/liter)	5 (38%)	4 (31%)	4 (31%)	13	1.9
Strontium-90 (150.5 or 151.2 pCi/liter)	7 (58%)	0	5 (42%)	12	8.7

[a] Measured concentration equal to or within 2σ of the known concentration.
[b] Measured concentration outside 2σ and equal to or within 3σ of the known concentration.
[c] Measured concentration outside 3σ of the known concentration.

is a function of current environmental levels. The number of samples analyzed at a particular sampling station under current conditions is reflected in the data presentation. Current levels for strontium-90 and cesium-137 are relatively stable over short periods of time, and sampling frequency is not critical. For the short-lived radionuclides, particularly iodine-131, the frequency of analysis is critical and is generally increased at the first measurement or recognition of a new influx of this radionuclide.

The data in table 2 show whether raw or pasteurized milk was collected. An analysis (*6*) of raw and pasteurized milk samples collected during January 1964 to June 1966 indicated that for relatively similar milkshed or sampling areas, the differences in concentration of radionuclides in raw and pasteurized milk are not statistically significant (*6*). Particular attention was paid to strontium-90 and cesium-137 in that analysis.

Practical reporting levels were developed by the participating networks, most often based on 2-standard-deviation counting errors or 2-standard-deviation total analytical errors from replicate analyses (*3*). The practical reporting level reflects analytical factors other than statistical radioactivity counting variations and will be used as a practical basis for reporting data.

The following practical reporting levels have been selected for use by all networks whose practical reporting levels were given as equal to or less than the given value.

Radionuclide	Practical reporting level (pCi/liter)
Strontium-89	5
Strontium-90	2
Iodine-131	10
Cesium-137	10
Barium-140	10

Some of the networks gave practical reporting levels greater than those above. In these cases, the larger value is used so that only data considered by the network as meaningful will be presented. The practical reporting levels apply to the handling of individual sample determinations. The treatment of measurements equal to or below these practical reporting levels for calculation purposes, particularly in calculating monthly averages, is discussed in the data presentation.

Analytical error or precision expressed as pCi/liter or percent in a given concentration range has also been reported by the networks (*3*). The precision errors reported for each of the radionuclides fall in the following ranges:

Radionuclide	Analytical errors of precision (2 standard deviations)
Strontium-89	1–5 pCi/liter for levels <50 pCi/liter; 5–10% for levels ≧50 pCi/liter;
Strontium-90	1–2 pCi/liter for levels <20 pCi/liter; 4–10% for levels ≧20 pCi/liter;
Iodine-131 Cesium-137 Barium-140	4–10 pCi/liter for levels <100 pCi/liter; 4–10% for levels ≧100 pCi/liter.

For iodine-131, cesium-137, and barium-140, there is one exception for these precision error ranges: 25 pCi/liter at levels <100 pCi/liter for Colorado. This is reflected in the practical reporting level for the Colorado milk network.

Federal Radiation Council guidance applicable to milk surveillance

In order to place the U.S. data on radioactivity in milk presented in *Radiation Data and Reports* in perspective, a summary of the guidance provided by the Federal Radiation Council for specific environmental conditions was presented in the February 1973 issue of *Radiation Data and Reports.*

Data reporting format

Table 2 presents the integrated results of the international, national, and State networks discussed earlier. Column 1 lists all the stations which are routinely reported in *Radiation Data and Reports.* The relationship between the PMN stations and the State stations is shown

Table 2. Concentrations of radionuclides in milk for March 1973 and 12-month period, April 1972 through March 1973

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:						
Ala:	Montgomery [c]	P	NA	5	0	5
Alaska:	Palmer [c]	P	5	4	0	3
Ariz:	Phoenix [c]	P	NA	0	0	0
Ark:	Little Rock [c]	P	9	9	0	2
Calif:	Sacramento [c]	P	NA	1	0	0
	San Francisco [c]	P	NA	0	0	0
	Del Norte	P	11	11	12	8
	Fresno	P	0	1	0	3
	Humboldt	P	4	3	0	2
	Los Angeles	P	2	1	0	2
	Mendocino	P	0	3	0	4
	Sacramento	P	2	2	0	3
	San Diego	P	2	1	0	4
	Santa Clara	P	0	2	0	3
	Shasta	P	0	2	0	5
	Sonoma	P	0	2	0	3
Colo:	Denver [c]	P	NA	3	0	0
	East	R	NS	NA	NS	5
	Northeast	R	NS	NA	NS	1
	Northwest	R	NA	NA	[d] 0	0
	South Central	R	NS	NS	NS	NS
	Southeast	R	NS	NA	NS	0
	Southwest	R	NA	NA	[d] 0	2
	West	R	NA	NA	[d] 0	3
Conn:	Hartford [c]	P	NA	5	0	4
	Central	P	NA	6	0	12
Del:	Wilmington [c]	P	NA	8	0	8
D.C:	Washington [c]	P	NA	6	0	3
Fla:	Tampa [c]	P	5	4	17	33
	Central	R	6	5	0	38
	North	R	8	7	12	13
	Northeast	R	6	5	0	30
	Southeast	R	7	5	30	43
	Tampa Bay area	P	6	5	18	33
	West	R	9	8	0	11
Ga:	Atlanta [c]	P	NA	9	13	9
Hawaii:	Honolulu [c]	P	0	2	0	1
Idaho:	Idaho Falls [c]	P	5	4	0	0
Ill:	Chicago [c]	P	5	5	0	6
Ind:	Indianapolis [c]	P	NA	5	0	1
	Central	P	3	7	15	9
	Northeast	P	5	6	10	9
	Northwest	P	6	8	10	11
	Southeast	P	5	7	10	7
	Southwest	P	6	7	10	10
Iowa:	Des Moines [c]	P	NA	4	0	0
	Iowa City	P	6	7	0	6
	Des Moines	P	5	6	0	3
	Little Cedar	R	NS	4	0	3
	Spencer	R	5	6	0	4
Kans:	Wichita [c]	P	NA	6	0	0
	Coffeyville	P	NA		0	9
	Dodge City	P	NA		0	6
	Falls City, Nebr	P	NA		0	7
	Hays	P	NA		0	7
	Kansas City	P	NA		11	8
	Topeka	P	NA		0	6
	Wichita	P	NA		0	5
Ky:	Louisville [c]	P	NA	7	0	3
La:	New Orleans [c]	P	11	11	0	2
Maine:	Portland [c]	P	NA	6	12	20
Md:	Baltimore [c]	P	NA	6	0	5
Mass:	Boston [c]	P	6	6	0	13
Mich:	Detroit [c]	P	NA	7	0	5
	Grand Rapids [c]	P	NA	7	0	8
	Bay City	P	5	4	0 (2)	3
	Charlevoix	P	7	4	3 (5)	7
	Detroit	P	4	4	0	4
	Grand Rapids	P	11	4	0	7
	Lansing	P	7	4	0 (2)	6
	Marquette	P	5	5	0 (2)	13
	Monroe	P	9	3	0 (2)	3
	South Haven	P	9	5	3 (4)	7
Minn:	Minneapolis [c]	P	NA	7	0	11
	Bemidji	P	5	6	0	15
	Duluth	P	15	14	18	28
	Fergus Falls	P	5	7	0	11
	Little Falls	P	15	17	16	38
	Mankato	P	5	5	0	11
	Marshall	P	4	3	0	0

See footnotes at end of table.

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Table 2. Concentrations of radionuclides in milk for March 1973 and 12-month period, April 1972 through March 1973—continued

Sampling location		Type of sample[a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average[b]	12-month average	Monthly average[b]	12-month average
UNITED STATES:						
Minn:	Minneapolis	P	10	9	12	11
	Rochester	P	6	7	0	0
Miss:	Jackson[e]	P	NA	9	11	8
Mo:	Kansas City[e]	P	NA	5	0	1
	St. Louis[e]	P	NA	6	0	1
Mont:	Helena[e]	P	NA	4	0	0
Nebr:	Omaha[e]	P	NA	5	0	0
Nev:	Las Vegas[e]	P	NA	1	0	0
N.H:	Manchester[e]	P	NA	7	12	14
N.J:	Trenton[e]	P	NA	7	0	5
N. Mex:	Albuquerque[e]	P	NA	1	0	0
N.Y:	Buffalo[e]	P	4	5	11	4
	New York City[e]	P	NA	8	0	5
	Syracuse[e]	P	NA	6	0	4
	Albany	P	4	4	17 (2)	0
	Buffalo	P	6	5	11	0
	Massena	P	NS	7	NS	0
	New York City	P	8	6	14	0
	Syracuse	P	5	5	NA	0
N.C:	Charlotte[e]	P	NA	8	0	5
N. Dak:	Minot[e]	P	NA	9	0	3
Ohio:	Cincinnati[e]	P	NA	5	0	3
	Cleveland[e]	P	NA	6	0	4
Okla:	Oklahoma City[e]	P	NA	5	0	1
Oreg:	Portland[e]	P	4	4	0	3
	Baker	P	NA		0	2
	Coos Bay	P	NA		13	6
	Eugene	P	NA		0	0
	Medford	P	NA		11	8
	Portland composite	P	NA		0	2
	Portland local	P	NA		0	1
	Redmond	P	NA		0	2
	Tillamook	R	NA		12	11
Pa:	Philadelphia[e]	P	NA	6	0	4
	Pittsburgh[e]	P	NA	8	12	7
	Dauphin	P	NA	4	0	6
	Erie	P	7	6	0	3
	Philadelphia	P	3	5	0	5
	Pittsburgh	P	3	7	0	7
R.I:	Providence[e]	P	NA	6	11	11
S.C:	Charleston[e]	P	5	8	0	9
	Chapin	R	NS	8	NS	14
	Clemson	R	NS	7	NS	8
	Columbia	R	NS	7	NS	11
	Fairfield	R	NS	6	NS	18
	Hartsville (02)	R	7	6	NA	11
	Hartsville (03)	R	NS	17	NS	18
	Lee County	R	7	8	NA	18
	Oconee County	R	NS	8	NS	12
	Pickens	R	NS	7	NS	13
	Williston	R	NS	7	NS	15
	Winnsboro	R	NA	9	NA	30
S. Dak:	Rapid City[e]	P	NA	5	0	1
Tenn:	Chattanooga[e]	P	NA	8	0	6
	Memphis[e]	P	NA	7	0	1
	Chattanooga	P	6	9	0	8
	Clinton	R	[illegible]	8	12	11
	Fayetteville	R	6	8	0 (2)	7
	Kingston	R	5	8	0 (2)	4
	Knoxville	P	4	7	0 (2)	5
	Lawrenceburg	R	5	6	12	8
	Nashville	P	NS	8	NS	6
	Pulaski	R	8	6	0	7
	Sequoyah	R	NS	7	NS	13
Tex:	Austin[e]	P	NA	2	0	0
	Dallas[e]	P	NA	5	0	0
	Amarillo	R	NA		NA	
	Corpus Christi	R	NA		NA	
	El Paso	R	NA		NA	
	Fort Worth	R	NA		NA	
	Harlingen	R	NA		NA	
	Houston	R	NA		NA	
	Lubbock	R	NA		NA	
	Midland	R	NA		NA	
	San Antonio	R	NA		NA	
	Texarkana	R	NA		NA	
	Uvalde	R	NA		NA	
	Wichita Falls	R	NA		NA	
Utah:	Salt Lake City[e]	P	3	3	0	2
Vt:	Burlington[e]	P	NA	5	0	8

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See footnotes at end of table.

Table 2. Concentrations of radionuclides in milk for March 1973 and 12-month period, April 1972 through March 1973—continued

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:						
Va:	Norfolk [c]	P	NA	6	0	6
Wash:	Seattle [c]	P	NA	3	0	1
	Spokane	P	NA	4	0	3
	Benton County	R	0	1	0	0
	Franklin County	R	NS	1	NS	0
	Longview	R	4	4	0	1
	Sandpoint, Idaho	R	6	7	0	6
	Skagit County	R	5	7	0	4
W. Va:	Charleston [c]	P	NA	7	0	5
Wisc:	Milwaukee [c]	P	NA	5	0	5
Wyo:	Laramie [c]	P	NA	2	0	0
CANADA:						
Alberta:	Calgary	P	4	6	5	12
	Edmonton	P	5	6	16	18
British Columbia:	Vancouver	P	5	7	11	19
Manitoba:	Winnipeg	P	5	5	13	14
New Brunswick:	Moncton	P	6	—	9	8
Newfoundland:	St. John's	P	10	17	16	22
Nova Scotia:	Halifax	P	7	8	7	13
Ontario:	Ottawa	P	5	6	7	8
	Sault Ste. Marie	P	9	10	19	20
	Thunder Bay	P	8	9	15	17
	Toronto	P	3	4	3	8
	Windsor	P	2	3	6	7
Quebec:	Montreal	P	5	6	7	9
	Quebec	P	8	8	10	17
Saskatchewan:	Regina	P	6	6	15	10
	Saskatoon	P	5	6	11	11
CENTRAL AND SOUTH AMERICA:						
Canal Zone:	Cristobal [c]	P	NA	1	35	16
Chile:	Santiago	P	0	1	0	1
Colombia:	Bogota	P	0	0	0 (2)	0
Ecuador:	Guayaquil	P	0	0	0	0
Jamaica:	Kingston	P	NS	2	NS	49
Puerto Rico:	San Juan [c]	P	NA	1	0	2
Venezuela:	Caracas	P	NS	1	NS	0
PMN network average [e]			5	5	2	4

[a] P, pasteurized milk.
R, raw milk.

[b] When an individual sampling result was equal to or less than the practical reporting level, a value of "0" was used for averaging. Monthly averages less than the practical reporting level reflect the fact that some but not all of the individual samples making up the average contained levels greater than the practical reporting level. When more than one analysis was made in a monthly period, the number of samples in the monthly average is given in parentheses.

[c] Pasteurized Milk Network station. All other sampling locations are part of the State or National network.

[d] The practical reporting level for this network differs from the general ones given in the text. Sampling results for these networks were equal to or less than the following practical reporting levels:

Cesium-137: Colorado—25 pCi/liter

[e] This entry gives the average radionuclide concentrations for the Pasteurized Milk Network stations denoted by footnote [c].
NA, no analysis.
NS, no sample collected.

in figure 2. The first column in table 2 under each of the reported radionuclides gives the monthly average for the station and the number of samples analyzed in that month in parentheses. When an individual sampling result is equal to or below the practical reporting level for the radionuclide, a value of zero is used for averaging. Monthly averages are calculated using the above convention. Averages which are equal to or less than the practical reporting levels reflect the presence of radioactivity in the some of the individual samples greater than the practical reporting level.

The second column under each of the radio-

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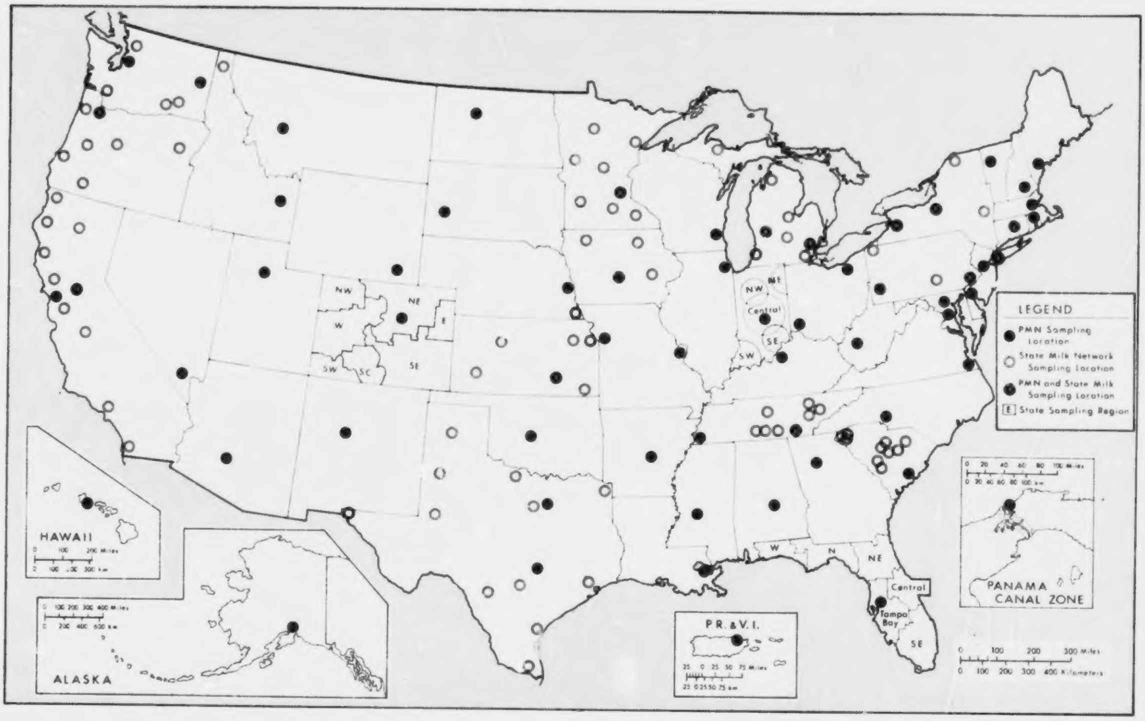
LEGEND
● PMN Sampling Location
○ State Milk Network Sampling Location
● PMN and State Milk Sampling Location
E State Sampling Region
HAWAII
ALASKA
P.R.&V.I.
PANAMA CANAL ZONE
Tampa Bay
Central
NW
NE
W
SW
SC
SE
E
N

Figure 2. State and PMN sampling stations in the United States

nuclides reported gives the 12-month average for the station as calculated from the preceding 12 monthly averages, giving each monthly average equal weight. Since the daily intake of radioactivity by exposed population groups, averaged over a year, constitutes an appropriate criterion for the case where the FRC radiation protection guides apply, the 12-month average serves as a basis for comparison.

Discussion of current data

In table 2, surveillance results are given for strontium-90 and cesium-137 for March 1973 and the 12-month period, April 1972 to March 1973. Except where noted, the monthly average represents a single sample for the sampling station. Strontium-89, iodine-131, and barium-140 data have been omitted from table 2 since levels at the great majority of the stations for March 1973 were below the respective practical reporting levels. Barium-140 results for individual samples were all below the practical reporting level with the following exception: Kansas City, Kansas (State), 13 pCi/liter. No strontium-89 or iodine-131 was detected.

Strontium-90 monthly averages ranged from 0 to 15 pCi/liter in the United States for March 1973 and the highest 12-month average was 17 pCi/liter (Little Falls, Minn. and Hartsville, S.C.) representing 8.5 percent of the Federal Radiation Council radiation protection guide. Cesium-137 monthly averages ranged from 0 to 30 pCi/liter in the United States for March 1973, and the highest 12-month average was 43 pCi/liter (Southeast Florida) representing 1.2 percent of the value derived from the recommendations given in the Federal Radiation Council report.

Acknowledgement

Appreciation is expressed to the personnel of the following agencies who provide data from their milk surveillance networks:

Bureau of Radiological Health
Environmental Health & Consumer Protection Program
California Department of Public Health

Radiation Protection Division
Canadian Department of National Health and Welfare

Radiological Health Section
Division of Occupational and Radiological Health
Colorado Department of Health

Radiological Health Services
Division of Medical Services
Connecticut State Department of Health

Radiological and Occupational Health Section
Department of Health and Rehabilitative Services
State of Florida

Bureau of Environmental Sanitation
Division of Sanitary Engineering
Indiana State Board of Health

Division of Radiological Health
Environmental Engineering Services
Iowa State Department of Health

Radiation Control Section
Environmental Health Division
Kansas State Department of Health

Radiological Health Services
Division of Occupational Health
Michigan Department of Health

Radiation Control Section
Division of Environmental Health
State of Minnesota Department of Health

Bureau of Radiological Pollution Control
New York State Department of Environmental Conservation

Environmental Radiation Surveillance Program
Division of Sanitation and Engineering
Oregon State Board of Health

Radiological Health Section
Bureau of Environmental Health
Pennsylvania Department of Public Health

Division of Radiological Health
South Carolina State Board of Health

Radiological Health Services
Division of Preventable Diseases
Tennessee Department of Public Health

Division of Occupational Health
Environmental Health Services
Texas State Department of Health

Radiation Control Section
Division of Health
Washington Department of Social and Health Services

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(*2*) U.S. ATOMIC ENERGY COMMISSION, DIVISION OF ISOTOPES DEVELOPMENT. Chart of the Nuclides, Tenth Edition revised to December 1968. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

(*3*) NATIONAL CENTER FOR RADIOLOGICAL HEALTH. Section I. Milk Surveillance. Radiol Health Data Rep 9:730–746 (December 1968).

(*4*) ROSENSTEIN, M. and A. S. GOLDIN. Statistical technics for quality control of environmental radioassay. Health Lab Sci 2:93 (April 1965).

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(*6*) ROBINSON, P. B. A comparison of results between the Public Health Service Raw Milk and Pasteurized Milk Networks for January 1964 through June 1966. Radiol Health Data Rep 9:475–488 (September 1968).

Raw Milk Sampling in South Carolina, October 1971 through February 1973[1]

Division of Radiological Health
South Carolina State Board of Health

As part of its radiological surveillance around nuclear facilities in the State, the Division of Radiological Health of the South Carolina State Board of Health, operates the Raw Milk Sampling Network (RMSN). The State RMSN presently consists of 12 locations distributed around 10 nuclear facility sites in South Carolina (figure 1).

With the cooperation of the dairyman, samples of raw milk are collected at each point from the bulk storage tank in the dairy barn. The 1-gallon sample is transported immediately to the Radiological Laboratory in Columbia for analysis. Several factors influenced the selection of RMSN stations. The major factor was the prevailing wind direction at a particular nuclear facility. The preferable sample location was identified from the published wind rose data available from the facility safety analysis reports. Selection of dairy farms was limited, however, because of economic and other reasons and these factors often resulted in sampling at the only locations available in some areas.

The RMSN involves sampling and analysis of raw milk in both preoperational and operational phases of the radiological surveillance program. The milk for all sampling stations in this report was collected quarterly in order to detect any seasonal, meteorological, or radio-

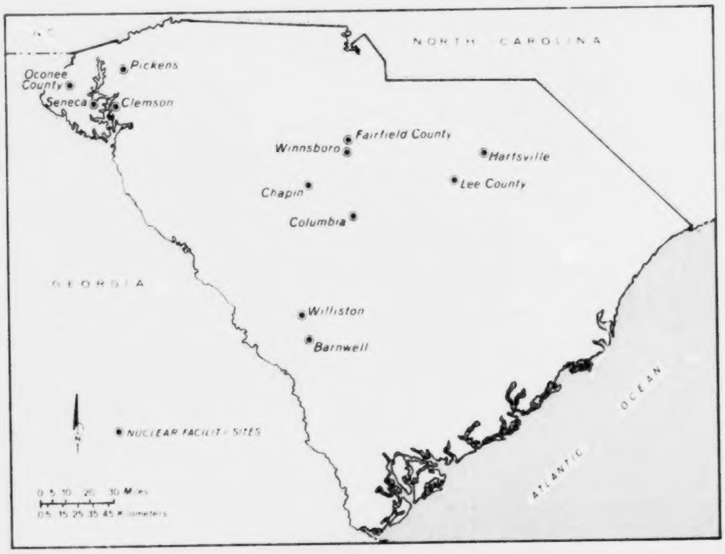
N.C.
NORTH CAROLINA
Pickens
Oconee County
Seneca
Clemson
Fairfield County
Winnsboro
Hartsville
Lee County
Chapin
Columbia
GEORGIA
Williston
Barnwell
NUCLEAR FACILITY SITES
0 5 10 20 30 Miles
0 5 15 25 35 45 Kilometers
ATLANTIC OCEAN

Figure 3. Raw milk sampling network stations in South Carolina

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[1] This report was presented by C. Nolan Bivens, MS, Division of Radiological Health, South Carolina State Board of Health.

Table 1. Results of radiological analysis on raw milk collected, South Carolina, October 1971 through December 1972

Site	Station number	Number of samples	Minimum detectable activity[a]	Strontium-89 (pCi/liter)	Strontium-90 (pCi/liter)	Iodine-131 (pCi/liter)	Cesium-137 (pCi/liter)	Barium-140 (pCi/liter)
Williston	40-4014	5	Maximum	2.1	9.4		38.4	
			Minimum	1.1	7.4	ND	12.0	ND
			Average	1.4	8.1		14.4	
Barnwell	40-4015	5	Maximum	2.4	11.6		57.6	
			Minimum	.6	7.5	ND	0	ND
			Average	1.5	9.6		23.8	
Columbia	40-4030	4	Maximum	2.5	8.0		19.1	
			Minimum	1.0	7.4	ND	6.3	ND
			Average	1.6	7.6		11.8	
Lee County	40-4001	5	Maximum	2.4	10.2		21.3	
			Minimum	.3	7.8	ND	0	ND
			Average	1.4	8.6		17.6	
Hartsville	40-4002	5	Maximum	2.5	7.9		24.0	
			Minimum	.5	4.7	ND	0	ND
			Average	1.6	6.0		9.7	
Hartsville	40-4003	5	Maximum	4.0	24.5		27.0	
			Minimum	2.1	17.0	ND	0	ND
			Average	3.0	19.5		18.5	
Pickens	40-4008	4	Maximum	2.6	8.7		18.0	
			Minimum	1.5	6.5	ND	5.0	ND
			Average	2.2	7.4		11.3	
Clemson	40-4009	6	Maximum	2.5	9.9		13.2	
			Minimum	.6	7.5	ND	0	ND
			Average	1.3	8.5		7.0	
Oconee County	40-4010	3	Maximum	1.2	10.3		16.4	
			Minimum	.4	9.1	ND	8.0	ND
			Average	.7	9.6		13.3	
Winnsboro	40-4020	4	Maximum	1.7	11.8		42.7	
			Minimum	.6	9.0	ND	11.2	ND
			Average	1.1	9.8		27.9	
Fairfield	40-4021	4	Maximum	1.7	7.6		23.0	
			Minimum	.6	4.6	ND	14.6	ND
			Average	1.1	6.2		19.5	
Chapin	40-0755	4	Maximum	2.2	11.3		17.7	
			Minimum	1.3	7.6	ND	12.7	ND
			Average	1.8	9.2		15.8	

[a] The minimum detectable activity for the following radionuclides is as follows: strontium-89, 0.3 pCi/liter; strontium-90,0.2 pCi/liter; iodine-131, 7.0 pCi/liter; cesium-137, 6.0 pCi/liter; barium-140, 7.0 pCi/liter.

ND, nondetectable activity. A value of 0 is used for averaging when the level of activity is less than the minimum detectable activity.

logical changes in an area. Records also are maintained on the size of the dairy herd, type feed, watering source, and any milk processor purchasing the raw milk.

Data are presented in table 1 for October 1971 through December 1972. Nuclear facility sites are referred to by number and may be identified on the map (figure 1). The minimum detectable activity reflects counting efficiency, chemical yields, and a 2-standard deviation counting error.

Radiostrontium is collected on an ion-exchange column, separated from radiobarium and counted using a Beckman Low Beta II gas-proportional counter. Gamma emitters are determined by scanning a 3-liter sample with a 3-inch NaI detector on a 512 channel Nuclear Data-130 system.

The Division of Radiological Health believes that the surveillance of raw milk is more meaningful than the collection and analysis of pasteurized milk in its monitoring of nuclear facilities. The South Carolina State Board of Health will continue monitoring raw milk from producers in South Carolina and will add new RMSN stations as other facilities are announced and as present facilities become operational.

The strontium-90 quarterly concentrations ranged from 4.7 to 24.5 pCi/liter for the first five quarters that the Raw Milk Sampling Network has been in operation (table 1). The highest five-quarter average is 17.0 pCi/liter (station number 40–4003) representing 7.5 percent of the Federal Radiation Council radiation protection guide. The cesium-137 quarterly concentration ranged from less than minimum

Table 2. Concentration of radionuclides in milk for January 1973 and 12-month period, February 1972 through January 1973[a]

Sampling location	Type of sample	Radionuclide concentration (pCi/liter)			
		Strontium-90		Cesium-137	
		Monthly average	12-month average	Monthly average	12-month average
South Carolina:					
Chapin-55	R	8	8	10	14
Clemson-09	R	NS	7	NS	9
Columbia-30	R	7	7	13	12
Fairfield-21	R	7	6	NA	20
Hartsville-02	R	NS	5	NS	11
Hartsville-03	R	17	17	18	19
Lee County-01	R	NS	7	NS	16
Oconee County-10	R	NS	9	NS	13
Pickens-08	R	NS	7	NS	15
Williston-14	R	NS	8	NS	16
Winnsboro-20	R	NS	9	NS	33

[a] U.S. milk surveillance data for January 1973 appears in the May 1973 issue of *Radiation Data and Reports*.

NS, no sample collected.

Table 3. Concentration of radionuclides in milk for February 1973 and 12-month period, March 1972 through February 1973[a]

Sampling location	Type of sample	Radionuclide concentration (pCi/liter)			
		Strontium-90		Cesium-137	
		Monthly average	12-month average	Monthly average	12-month average
South Carolina:					
Chapin-55	R	NS	8	NS	14
Clemson-09	R	6	6	0	8
Columbia-30	R	7	7	11	11
Fairfield-21	R	NS	6	NS	20
Hartsville-02	R	6	5	12	11
Hartsville-03	R	19	17	17	18
Lee County-01	R	NS	7	NS	16
Oconee County-10	R	NS	9	NS	13
Pickens-09	R	NS	7	NS	15
Williston-14	R	NS	8	NS	16
Winnsboro-20	R	NS	9	NS	33

[a] U.S. milk surveillance data for February 1973 appears in the June 1973 issue of *Radiation Data and Reports*.

NS, no sample collected.

detectable activity to 57.6 pCi/liter for the first five quarters that the RMSN began operations. The highest five-quarter average is 27.9 pCi/liter (station number 40–4020) representing 0.8 percent of the value derived from the Federal Radiation Council.

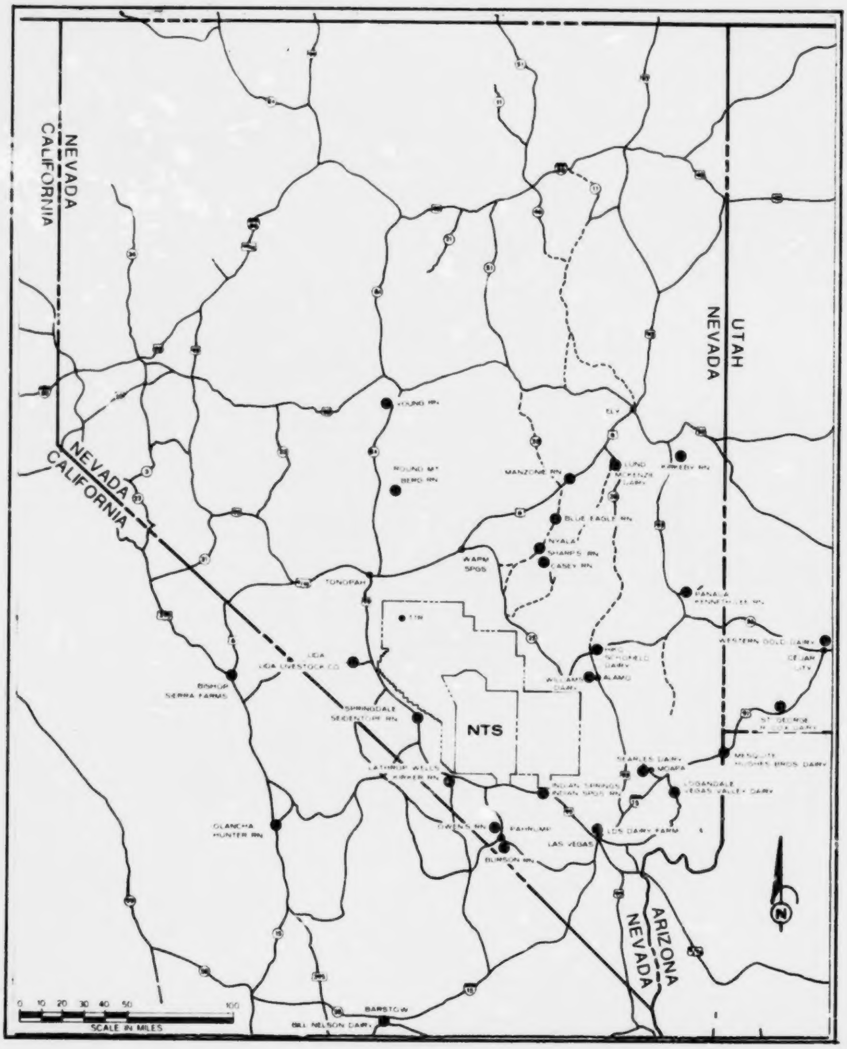
Table 2 gives the concentration of strontium-90 and cesium-137 in milk for January 1973 and table 3 gives the concentration for February 1973.

Two of the nuclear facilities were operational when the Raw Milk Sampling Network began. The remaining three facilities are under various stages of construction, therefore, no baseline to operational comparisons can be made.

Milk Surveillance Network, January 1973

National Environmental Research Center—
Las Vegas, Environmental Protection Agency

The National Environmental Research Center-Las Vegas (NERC-LV) is responsible for conducting radiological safety and environmental surveillance programs in the offsite area surrounding the Nevada Test Site (NTS) in support of nuclear testing conducted by the U.S. Atomic Energy Commission (AEC). When required, additional surveillance programs are established at locations other than around NTS in support of AEC operations. Beginning with the January 1972 report, the analytical results of milk samples collected for the above programs have been reported in *Radiation Data and Reports.*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LUND
McKENZIE DAIRY
KIRKEBY RN
BLUE EAGLE RN
NYALA
SHARPS RN
CASEY RN
WARM SPGS
TONOPAH
PANACA
KENNETH LEE RN
WESTERN GOLD DAIRY
CEDAR CITY
HIKO
SCHOFIELD DAIRY
WILLIAMS DAIRY
ALAMO
LIDA
LIDA LIVESTOCK CO
BISHOP
SERRA FARMS
SPRINGDALE
SEIDENTOPF RN
NTS
ST GEORGE
SEARLES DAIRY
MOAPA
MESQUITE
HUGHES BROS DAIRY
LATHROP WELLS
KIRKER RN
INDIAN SPRINGS
INDIAN SPGS RN
LOGANDALE
VEGAS VALLEY DAIRY
OLANCHA
HUNTER RN
OWENS RN
PAHRUMP
LDS DAIRY FARM
LAS VEGAS
BURSON RN
BARSTOW
BILL NELSON DAIRY
0 10 20 30 40 50 100
SCALE IN MILES
N

Figure 1. NERC-LV Milk Surveillance Network

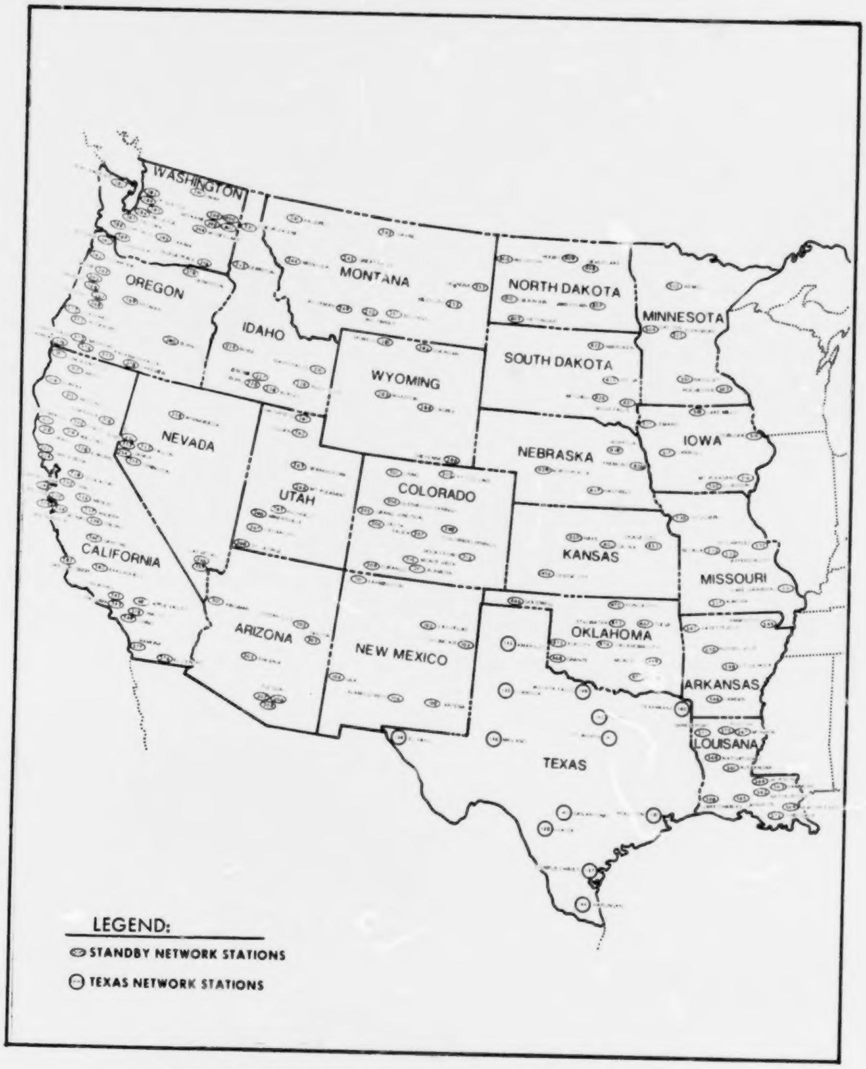
WASHINGTON
OREGON
IDAHO
MONTANA
NORTH DAKOTA
MINNESOTA
SOUTH DAKOTA
WYOMING
NEVADA
UTAH
COLORADO
NEBRASKA
IOWA
KANSAS
MISSOURI
CALIFORNIA
ARIZONA
NEW MEXICO
OKLAHOMA
ARKANSAS
LOUISANA
TEXAS
LEGEND:
STANDBY NETWORK STATIONS
TEXAS NETWORK STATIONS

Figure 2. NERC-LV Standby Milk Surveillance Network

The Milk Surveillance Networks[1] operated by the NERC-LV are the routine Milk Surveillance Network (MSN) and the Standby Milk Surveillance Network (SMSN). The MSN, shown in figure 1, consists of 24 regular and two alternate locations at which NERC-LV personnel collect 1-gallon milk samples on a monthly basis from family milk cows, commercial pasteurized milk, Grade A raw milk for pasteurization, and Grade A raw milk for local consumption. In the event of a release of radioactivity from the NTS, intensive sampling is conducted in the affected area out to about 300 miles of the NTS to determine radionuclide concentrations in milk, and to assess radiation doses that could result from the ingestion of the milk. Milk supplies and producers beyond 300 miles are sampled by the SMSN.

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[1] These programs are operated under a Memorandum of Understanding (No. AT(26-1)-539) with the Nevada Operations Office, Las Vegas, Nev.

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Previously, the network consisted of 32 regular and five alternate sampling locations, as described in the December 1972 issue of *Radiation Data and Reports*. A reduction of sampling locations was implemented this year to economize operations and yet provide adequate coverage in the event of a release.

The SMSN (*1*), shown in figure 2, consists of about 185 Grade A milk processing plants which can be requested by telephone to collect raw milk samples representing milksheds supplying milk to the plants. Samples from the network are collected and mailed to the NERC-LV through the cooperation of Federal, State, and local government agencies in the event of a release of radioactivity at NTS or other test locations. Periodically, one sample is collected from each station to maintain network readiness and to check the network's reliability.

Analytical procedures

All routine samples are analyzed for gamma-emitting radionuclides by gamma spectroscopy, and for radiostrontium on a quarterly basis by radiochemistry procedures. Samples collected at Las Vegas and at five locations which have often been within downwind trajectories from the NTS during tests are also analyzed for tritium. Special or event-related samples are normally gamma scanned. Further analyses depend on whether radioactivity is detected and/or on special requirements of the sampling program. During readiness checks of the SMSN, only random samples are analyzed for strontium-89, strontium-90, and tritium.

Table 1 lists the general analytical procedures and detection limits, as described by Johns (*2*), and Lem and Snelling (*3*). For gamma spectroscopy analyses, the samples are placed in 3.5-liter inverted-well Marinelli beakers. All routine samples are counted for 40 minutes. Special samples collected following known releases of activity are normally counted 20 minutes, but this will vary from 10 to 40 minutes depending on radionuclide concentration and sample workload. The activity concentration of each of the detected nuclides at the time of count is calculated and extrapolated to time of collection.

Results

The analytical results of all milk samples collected in January 1973 by the NERC-LV milk surveillance program are listed in table 2. With the exception of cesium-137 at levels near the minimum detectable activity (MDA) of 10 pCi/liter, no gamma-emitting fission products were identified by gamma spectrometry in any of the samples collected in January. Levels of tritium and strontium-90 near the MDA's for these radionuclides (≈200 PCi/liter and 1 pCi/liter, respectively) were also measured by radiochemistry analyses.

Table 1. Analytical procedures

Type of analysis	Analytical equipment	Counting period (min.)	Analytical procedures	Sample size (liter)	Detection limits (pCi/liter)
Gamma spectroscopy	Gamma spectrometer with a 10 by 10-cm NaI(Tl) crystal with input to 200 channels (0–2 MeV) of 400-channel, pulse-height analyzer.	10–40	Radionuclide concentrations quantitated from gamma spectrometer data by computer using an eight element matrix technique.	3.5	Generally 10 pCi/liter for most common fallout radionuclides in a simple spectrum.
Strontium-89, -90	Low background thin-window, gas-flow proportional counter with a 5.7 cm diameter window (80 $\mu g/cm^2$)	50	Chemical separation by ion exchange. Separated sample counted successively; activity calculated by simultaneous equations.	1.0	[a] $^{89}Sr = 5$ [a] $^{90}Sr = 2$
Tritium	Automatic liquid scintillation counter with output printer.	100	Sample prepared by distillation.	.005	[a], [b] ≈320

[a] The detection limit for a given sample is defined as that concentration which is equal to the 2-sigma counting error.

[b] The detection limit for samples analyzed during February 1972 and thereafter was ≈220 pCi/liter.

Table 2. Milk surveillance results, January 1973

Location	Date collected (1973)	Sample type[a]	Radionuclide concentrations[b] (pCi/liter)			
			^{137}Cs	^{89}Sr	^{90}Sr	^{3}H
California:						
Bishop:						
Sierra Farms	1/3	11	<10	<2.0	1.5 ±1.4	NA
Hinkley:						
Bill Nelson Dairy	1/3	12	<10	<2.0	<1.1	NA
Olancha:						
Hunter Ranch	1/3	13	<10	<2.0	1.7 ±1.2	NA
Nevada:						
Alamo:						
Williams Dairy	1/11	12	<10	<2.0	<1.3	NA
Austin:						
Young's Ranch	1/15	13	<10	<2.0	3.9 ±1.7	670 ±250
Currant:						
Blue Eagle Ranch	1/10	13	20	<2.0	2.8 ±1.4	NA
Mazonie Ranch	1/9	13	<10	<2.0	<1.4	NA
Hiko:						
Schofield Dairy	1/8	12	<10	<2.0	<1.3	420 ±240
Indian Springs:						
Indian Springs Ranch	1/11	13	<10	<1.0	<1.0	NA
Las Vegas:						
LDS Dairy Farms	1/15	12	<10	<2.0	<1.1	<250
Lathrop Wells:						
William J. Kirker	1/9	13	<10	<2.0	1.4 ±1.3	NA
Lida:						
Lida Livestock Co	1/14	13	<10	<2.0	<1.2	NA
Logandale:						
Vegas Valley Dairy	1/12	12	<10	<1.0	<1.0	NA
Lund:						
McKenzie Dairy	1/11	12	10	<2.0	6.1 ±1.6	<230
Mesquite:						
Hughes Bros. Dairy	1/8	12	10	<2.0	<1.5	320 ±240
Moapa:						
Searles Dairy	1/8	12	<10	<2.0	1.3 ±1.3	NA
Nyala:						
Sharp's Ranch	1/16	13	<10	[c] NA	[c] NA	<250
Pahrump:						
Owens Ranch	1/11	13	<10	<1.0	<1.1	NA
Panaca:						
Kenneth Lee Ranch	NS					
Round Mt:						
Russell Berg	NS					
Shoshone:						
Kirkeby Ranch	1/11	13	<10	<2.0	2.6 ±1.4	NA
Springdale:						
Seidentopf Ranch	1/10	13	<10	<2.0	<1.3	NA
Utah:						
Cedar City:						
Western Gold Dairy	1/9	12	<10	<2.0	5.1 ±1.7	NA
St. George:						
R. Cox Dairy	1/8	12	<10	<2.0	<1.5	NA

[a] 11—Pasteurized milk.
12—Raw milk from Grade A producer(s).
13—Raw milk from family cow(s).

[b] Two-sigma counting error provided when available.

[c] Not analyzed because sample was sour.

NA, not analyzed.

NS, no sample.

REFERENCES

(*1*) SHARPE, T. J. and J. L. STEIN. Standby Milk Surveillance Network. Radiol Health Data 8:379–382 (August 1970).

(*2*) JOHNS, F. B. Southwestern radiological health handbook of radiochemical analytical methods, SWRHL–11. Southwestern Radiological Health Laboratory, Las Vegas, Nev. (March 1970).

(*3*) LEM, P. N. and R. N. SNELLING. Southwestern Radiological Health Laboratory data analysis and procedures manual, SWRHL–21. Southwestern Radiological Health, Laboratory, Las Vegas, Nev. (March 1971).

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Food and Diet Surveillance

Efforts are being made by various Federal and State agencies to estimate the dietary intake of selected radionuclides on a continuing basis. These estimates, along with the guidance developed by the Federal Radiation Council, provide a basis for evaluating the significance of radioactivity in foods and diet.

Networks presently in operation and reported routinely include those listed below. These networks provide data useful for developing estimates of nationwide dietary intake of radionuclides. Programs reported in *Radiation Data and Reports* are as follows:

Program	Period reported	Issue
California Diet Study	January–June 1971	December 1972
Carbon-14 in Total Diet and Milk	July–December 1971	May 1972
Radiostrontium in Milk	January–December 1971	November 1972
Strontium-90 in Tri-City Diets	January–December 1971	December 1972

Radionuclides in Institutional Diet Samples, April-June 1972

Environmental Protection Agency and
Food and Drug Administration

The determination of radionuclide concentrations in the diet constitutes an important element of an integrated program of environmental radiological surveillance and assessment. Recognizing that the diet is a potentially significant contribution to total environmental radiation exposures, the Public Health Service initiated its Institutional Diet Sampling Program in 1961. The program is now administered by the Office of Radiation Programs, Environmental Protection Agency with the assistance of the Office of Food Sanitation, Food and Drug Administration, Department of Health, Education, and Welfare (*1*).

This program estimates the dietary intake of radionuclides in a selected population group, ranging from children to young adults of school age. At present, 26 institutions—distributed geographically as shown in figure 1—are being sampled. Previous results showed that the daily dietary intake of teenage girls and children from 9 to 12 years of age were comparable, but teenage boys consumed 20 percent more food per day (*1*, *2*). Extrapolating this information, estimates for teenage boys and/or girls can be calculated on the basis of the dietary intake of children.

The sampling procedure is generally the same at each institution. Each sample represents the edible portion of the diet for a full 7-day week (21 meals plus between-meal snacks), obtained by duplicating the food intake of a different individual daily. Drinking water—which is not included—is also sampled periodically. Each daily sample is kept frozen until the end of the collection period. It is then packed in dry ice and shipped by air to either the National Environmental Research Center, Las Vegas, Nev., or the Eastern Environmental Radiation Facility, Montgomery, Ala. A detailed description of sampling and analytical procedures has already been presented in *Radiological Health Data and Reports* (*3*).

Results

Table 1 shows the analytical results for institutional diet samples collected from all stations during April–June 1972. The stable elements, calcium and potassium are reported in

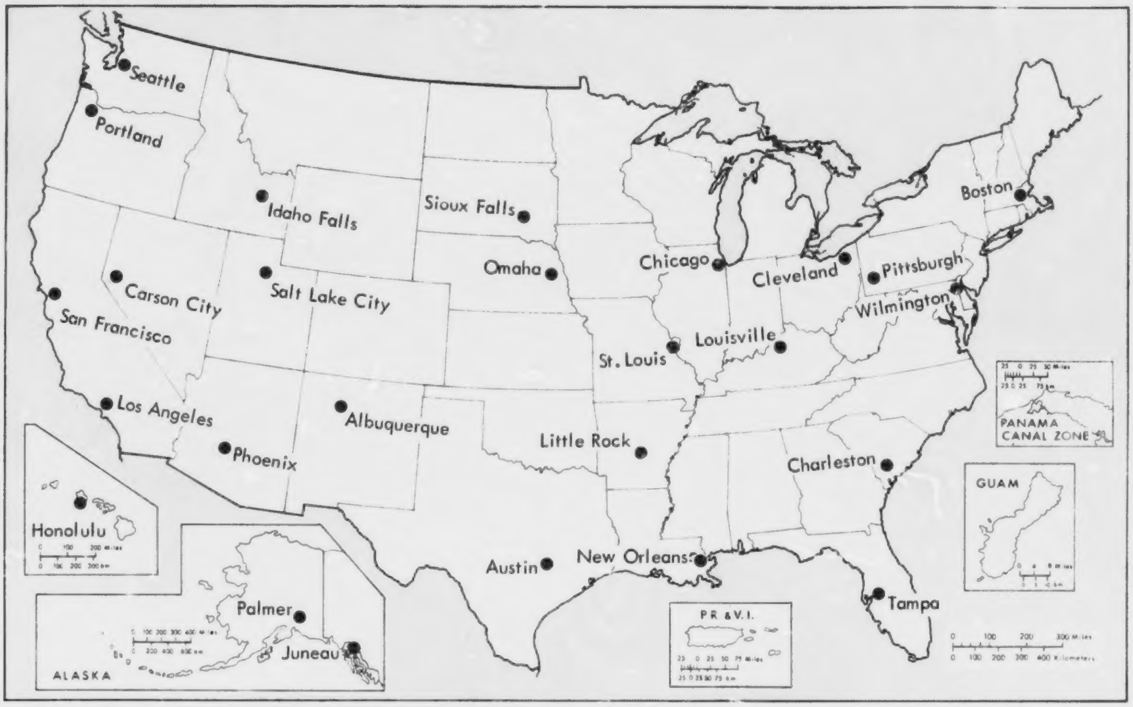
Seattle
Portland
Idaho Falls
Sioux Falls
Omaha
Chicago
Cleveland
Pittsburgh
Boston
Wilmington
Carson City
Salt Lake City
San Francisco
Louisville
St. Louis
Los Angeles
Albuquerque
Phoenix
Little Rock
Charleston
Honolulu
Austin
New Orleans
Tampa
Palmer
Juneau
ALASKA
PR & V.I.
PANAMA CANAL ZONE
GUAM

Figure 1. Institutional diet sampling locations as of June 1972

Table 1. Concentration and intake of stable elements and radionuclides in institutional total diets of children April-June 1972

Location of Institution		Month (1972)	Total weight (kg/day)	Calcium		Potassium		Strontium-90		Cesium-137	
				(g/kg)	(g/day)	(g/kg)	(g/day)	(pCi/kg)	(pCi/day)	(pCi/kg)	(pCi/day)
Alaska:	Juneau	April[a]	2.97	0.7	2.0	1.4	4.0	3	10	14	42
	Palmer		NS								
Ariz:	Phoenix	April	1.52	.5	.7	2.2	3.3	4	5	0	0
Ark:	Little Rock	April	1.48	.7	1.0	1.7	2.5	7	11	0	0
Calif:	Los Angeles		NS								
	San Francisco	April[a]	2.06	.6	1.2	1.5	3.0	3	6	0	0
Del:	Wilmington	April[a]	.84	.6	.5	1.5	1.3	5	4	12	10
Fla:	Tampa	April	3.31	.5	1.8	1.4	4.7	4	14	15	50
Hawaii:	Honolulu	April	2.34	.4	1.1	1.7	3.9	4	8	0	0
Idaho:	Idaho Falls	April[a]	1.06	.4	.4	1.5	1.6	4	4	0	0
Ill:	Chicago	April[a]	1.92	.7	1.3	1.5	2.8	6	11	14	27
Ky:	Louisville	April	1.88	.7	1.2	1.5	2.7	6	11	12	23
La:	New Orleans	April[a]	1.58	.6	.9	1.6	2.6	7	11	12	19
Mass:	Boston	April	2.47	.5	1.3	1.3	3.1	4	10	0	0
Mo:	St. Louis	April[a]	1.06	.8	.9	1.9	2.1	4	5	18	20
Nebr:	Omaha	April[a]	1.80	.7	1.2	1.5	2.7	0	0	0	0
Nev:	Carson City	April	1.36	.9	1.2	1.6	2.2	4	6	0	0
N. Mex:	Albuquerque		NS								
Ohio:	Cleveland	April[a]	1.49	.7	1.0	1.7	2.5	4	6	12	18
Oreg:	Portland	April[a]	2.19	.6	1.2	1.8	3.9	3	7	17	37
Pa:	Pittsburgh	April	2.39	.5	1.2	1.3	3.1	4	11	0	0
S.C:	Charleston	April	2.22	.6	1.3	1.5	3.2	5	11	15	35
S. Dak:	Sioux Falls	April[a]	1.20	.7	.8	1.4	1.6	5	6	0	0
Tex:	Austin	April[a]	1.09	.8	.8	2.5	2.8	6	6	0	0
Utah:	Salt Lake City	April[a]	2.76	.6	1.7	1.4	3.8	3	8	13	36
Wash:	Seattle	April[a]	1.80	.5	.9	1.8	3.2	3	5	11	20
Institutional average			1.86	0.6	1.1	1.6	2.9	4	8	7	14

[a] Food samples were collected from two or more children who were not between the ages of 9 and 12.

Note: Iodine-131 and barium-140 were not detected at any station during this period. Omaha, Nebr. had a strontium-89 concentration of 7 pCi/kg or 13 pCi/day.

NS, no sample.

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g/kg of diet. When applicable, radionuclide concentrations of these samples reported in pCi/kg of diet are corrected for radioactive decay to the midpoint of the sample collection period. Dietary intakes in g/day or pCi/day were obtained by multiplying the food consumption rate in kg/day by the appropriate concentration values. The average food consumption rate during this period was 1.86 kg/day compared to the network average of 1.85 kg/day observed from 1961 through 1971.

Strontium-90 dietary intake averaged 8 pCi/day during this period. Cesium-137 intake averaged 14 pCi/day. These results fall within Range I as defined by the former Federal Radiation Council (*4*). Barium-140 and iodine-131 concentrations were below detectable levels. Strontium-89 was detected in Omaha, Nebr.

All concentrations less than or equal to the appropriate minimum detectable level have been reported as zero. The minimum detectable concentration is defined as the measured concentration equal to the 2-standard-deviation analytical error. Accordingly, the minimum detectable limits are strontium-89, 5 pCi/kg; strontium-90, 2 pCi/kg; iodine-131, 10 pCi/kg; barium-140, 10 pCi/kg; and cesium-137, 10 pCi/kg.

Recent coverage in *Radiation Data and Reports:*

Period	Issue
April–June 1971	November 1971
July–September 1971	April 1972
October–December 1971	June 1972
January–March 1972	June 1973

REFERENCES

(*1*) ANDERSON, E. C., D. J. NELSON, JR. Surveillance for radiological contamination in foods. Amer J Public Health 52:1391–1400 (September 1962).

(*2*) PUBLIC HEALTH SERVICE, DIVISION OF RADIOLOGICAL HEALTH. Radionuclides in institutional total diet samples, January–March 1965. Radiol Health Data 6:548–554 (October 1965).

(*3*) PUBLIC HEALTH SERVICE, NATIONAL CENTER FOR RADIOLOGICAL HEALTH. Radionuclides in institutional total diet samples, January–March 1968. Radiol Health Data Rep 9:557–560 (October 1968).

(*4*) FEDERAL RADIATION COUNCIL. Background material for the development of radiation protection standards, Report No. 2. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (September 1961).

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SECTION II. WATER

The Environmental Protection Agency and other Federal, State, and local agencies operate extensive water quality sampling and analysis programs for surface, ground, and treated water. Most of these programs include determinations of gross beta and gross alpha radioactivity and specific radionuclides.

Although the determination of the total radionuclide intake from all sources is of primary importance, a measure of the public health importance of radioactivity levels in water can be obtained by comparison of the observed values with the Public Health Service Drinking Water Standards (*1*). These standards, based on consideration of Federal Radiation Council (FRC) recommendations (*2–4*) set the limits for approval of a drinking water supply containing radium-226 and strontium-90 at 3 pCi/liter and 10 pCi/liter, respectively. Higher concentrations may be acceptable if the total intake of radioactivity from all sources remains within the guides recommended by FRC for control action. In the known absence[1] of strontium-90 and alpha-particle emitters, the limit is 1,000 pCi/liter gross beta radioactivity, except when additional analysis indicates that concentrations of radionuclides are not likely to cause exposures greater than the limits indicated by the Radiation Protection Guides. Surveillance data from a number of Federal and State programs are published periodically to show current and long-range trends. Water sampling activities reported in *Radiation Data and Reports* are listed below.

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[1] Absence is taken to mean a negligibly small fraction of the specific limits of 3 pCi/liter and 10 pCi/liter for unidentified alpha-particle emitters and strontium-90, respectively.

Water sampling program	Period reported	Issue
California	January–December 1970	June 1972
Colorado River Basin	1968	March 1972
Community Water Supply Study	1969	September 1972
Florida	1969	January 1972
Interstate Carrier Drinking Water	1971	May 1972
Kansas	January–December 1971	February 1973
Minnesota	July 1970–June 1971	November 1972
New York	July–December 1970 and January–June 1971	May 1972
North Carolina	1968–1970	September 1972
Radiostrontium in Tap Water, *HASL*	July–December 1971	November 1972
Washington	July 1969–June 1970	March 1972
Water Surveillance Programs, *NERC-LV*	December 1972	June 1973

REFERENCES

(*1*) U.S. PUBLIC HEALTH SERVICE. Drinking water standards, revised 1962, PHS Publication No. 956. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (March 1963).

(*2*) FEDERAL RADIATION COUNCIL. Radiation protection guidance for Federal Agencies. Memorandum for the President, September 1961. Reprint from the Federal Register of September 26, 1961.

(*3*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 1. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (May 1960).

(*4*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 2. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (September 1961).

Gross Radioactivity in Surface Waters of the United States January 1969-December 1970

Office of Water Planning and Standards
U.S. Environmental Protection Agency

The monitoring of gross radioactivity in surface waters of the United States was initiated in 1957 as part of the Water Pollution Surveillance System (formerly National Water Quality Network) of the U.S. Public Health Service. Currently, the program is operated by the U.S. Environmental Protection Agency, Office of Water Planning and Standards. Regional offices of the Environmental Protection Agency are responsible for the collection and retrieval system. Radioactivity analyses were performed in the centralized laboratories of the Office of Water Planning and Standards (Cincinnati, Ohio).

Table 1 presents the gross alpha and beta radioactivity results for samples collected during January 1969–December 1970. The analytical procedures used for determining gross alpha and beta radioactivity are described in the 13th Edition of *Standard Methods for the Examination of Water and Wastewater* (*1*). Results are presented for the date of counting and are not corrected to the date of collection. The sensitivity in counting is that defined by the National Bureau of Standards, Handbook 86 (*2*) and is calculated to be <0.2 pCi/liter for gross alpha radioactivity and <1 pCi/liter for gross beta radioactivity measurements.

REFERENCES

(*1*) AMERICAN PUBLIC HEALTH ASSOCIATION: AMERICAN WATER WORKS ASSOCIATION AND WATER POLLUTION CONTROL FEDERATION. Standard methods for the examination of water and wastewater, 13th Edition, New York, N.Y. (1971).

(*2*) U.S. DEPARTMENT OF COMMERCE. Radioactivity, Recommendations of the International Commission on Radiological Units and Measurements (1962), NBS Handbook 86 (November 29, 1963).

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1969				
Ohio River:						
Evansville, Ind	4	1/2	0.8	<1.0	<1	<2
Cuyahoga River:						
Cleveland, Ohio	4	3/26	.4	1.7	0	<3
Lake Erie:						
Buffalo, N.Y	4	3/26	<.2	<1.1	0	<2
Maumee River:						
Toledo, Ohio	4	3/26	.8	2.2	10	25
Ohio River:						
Cane Run, Ky	4	3/25	1.1	<.6	6	5
Louisville, Ky	4	3/25	1.4	.3	5	5
Clinch River:						
Kingston, Tenn	(b)	5/5	<.2	.7	0	30
		5/12	<.2	<.5	0	28
		5/19	<.2	<.4	1	8
		5/26	<.2	3.0	2	42
Mississippi River:						
Cape Girardeau, Mo	4	5/26	1.4	.9	25	25
Allegheny River:						
Pittsburgh, Pa	4	6/16	<.2	<1.7	0	8
	4	6/30	.3	<.9	0	4
Arkansas River:						
Fort Smith, Ark	4	6/25	2.0	.4	11	8
Little Rock, Ark	4	6/25	2.4	<1.5	8	7
Pendleton Ferry, Ark	4	6/25	1.5	<1.2	6	9
Ponca City, Okla	4	6/30	5.2	.5	38	9
Atchafalaya River:						
Morgan City, La	(b)	6/3	2.2	.6	8	7
Big Sioux River:						
Sioux Falls, S. Dak	(b)	6/18	.9	21.1	7	52
		6/25	.8	.9	8	22
Chattahoochee River:						
Columbus, Ga	4	6/30	.7	<.2	2	2
Lanett, Ala	4	6/30	.9	<.3	4	2
Clinch River:						
Kingston, Tenn	(b)	6/2	<.2	.5	1	8
		6/9	<.2	.2	4	4
		6/23	<.2	1.6	0	11
		6/30	<.2	1.0	0	11
Coosa River:						
Rome, Ga	4	6/25	<.3	<.3	1	10
Cuyahoga River:						
Cleveland, Ohio	4	6/25	.2	7.4	5	13
Delaware River:						
Mastens Creek, Pa	(b)	6/19	.9	<.3	9	5
Philadelphia, Pa	(b)	6/18	.4	<.4	2	4
Trenton, N.J	(b)	6/16	2.1	.3	11	3
Escambia River:						
Century, Fla	4	6/25	.4	<.5	3	7
Great Miami:						
American Materials Bridge, Ohio	(b)	6/18	<.3	1.9	4	7
Lost Bridge, Ohio	(b)	6/18	1.5	.9	11	24
Sellars Road, Ohio	(b)	6/18	.6	1.9	4	7
Green River:						
Spotsville, Ky	(b)	6/25	1.7	<.8	7	3
Hudson River:						
Poughkeepsie, N.Y	(b)	6/19	<.2	<.4	1	4
Kanawha River:						
Mason County, W. Va	4	6/24	.3	<.3	1	1
Winfield Dam, W. Va	4	6/30	<.3	<.7	0	2
Kansas River:						
Holliday, Kans	(b)	6/16	10.5	1.6	63	18
		6/23	7.9	.9	48	13
		6/30	11.3	1.5	65	13
Lake Erie:						
Buffalo, N.Y	4	6/25	<.2	3.4	0	3
Licking River:						
Covington, Ky	(b)	6/19	.4	<.7	4	7
Little Miami River:						
Cincinnati, Ohio	(b)	6/18	.8	<1.2	8	6
Maumee River:						
Toledo, Ohio	4	6/25	<.4	.3	7	8
Merrimac River:						
Lowell, Mass	(b)	6/24	<.2	<.4	3	7
Mississippi River:						
Vicksburg, Miss	4	6/23	2.5	.2	12	6
	(b)	6/24	<.9	<.3	14	6
West Memphis, Ark	4	6/23	3.5	.6	10	7
Missouri River:						
Bismarck, N. Dak	4	6/17	<.2	<.8	0	2
	(b)	6/17	<.3	2.7	1	10
	(b)	6/24	<.2	3.5	1	14
St. Joseph, Mo	4	6/17	3.5	1.9	20	20

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1969				
Monongahela River:						
Pittsburgh, Pa	4	6/20	<.2	.9	0	4
	4	6/16	.8	.4	2	<1
North Platte River:						
Henry, Nebr	(b)	6/16	.6	43.0	7	68
	(b)	6/23	<.2	19.4	3	51
	(b)	6/30	.5	17.5	4	29
Ohio River:						
Addison, Ohio	4	6/20	1.0	<.8	2	6
Anderson Ferry, Ohio	(b)	6/19	.3	<.9	2	5
Boyd County, Ky	4	6/10	<.3	<.8	0	4
Cane Run, Ky	(b)	6/24	<.3	<.8	3	6
Cincinnati, Ohio	(b)	6/18	<.2	<.9	0	8
	(b)	6/18	.2	<1.3	1	11
East Liverpool, Ohio	4	6/17	<.3	<1.0	0	3
Evansville, Ind	4	6/25	1.1	<.9	9	6
Gallipolis, Ohio	4	6/25	<.2	<.7	0	2
Greenup Dam, Ky	(b)	6/18	.2	<1.1	1	5
Ironton, Ohio	(b)	6/18	<.3	<.9	1	4
	(b)	6/18	23.3	.3	0	1
Kyger Creek, W. Va	4	6/25	.3	.3	1	4
Louisville, Ky	(b)	6/24	1.5	<.8	7	6
Madison, Idaho	(b)	6/19	.2	<.9	2	7
Marietta, Ohio	4	6/20	<.2	<.8	0	3
Markland, Dam, Ky	(b)	6/19	<.2	<1.5	1	16
Maysville, Ky	(b)	6/18	.7	<1.1	5	25
Meldahl Dam, Ohio	(b)	6/19	<.2	<.8	1	5
Miami Fort, Ohio	(b)	6/18	1.8	.3	3	5
New Martinsville, Ohio	4	6/16	<.2	<.8	0	4
Old Lock #19, W. Va	4	6/24	<.3	<.9	0	4
Portsmouth, Ohio	(b)	6/18	.4	<.7	1	4
	(b)	6/18	.5	<.8	2	4
Warwood, W. Va	4	6/18	<.2	<.8	0	3
Platte River:						
Plattsmouth, Nebr	(b)	6/17	4.9	2.4	26	15
Red River:						
Dennison, Tex	4	6/30	<.2	<2.8	0	12
Index, Ark	(b)	6/10	2.2	.8	9	53
Rio Grande:						
Brownsville, Tex	4	6/30	.2	1.7	0	13
El Paso, Tex	4	6/11	1.7	2.7	7	20
Laredo, Tex	4	6/30	.6	1.0	8	11
Sabine River:						
Ruliff, Tex	(b)	6/17	1.2	.3	4	7
Schuylkill River:						
Philadelphia, Pa	(b)	6/16	.4	<1.0	3	7
Scioto River:						
Lucasville, Ohio	(b)	6/18	2.6	1.1	18	10
South Platte River:						
Julesburg, Colo	(b)	6/11	6.6	43.2	39	60
	(b)	6/25	7.0	16.2	30	48
	(b)	6/30	4.8	49.0	16	75
Tennessee River:						
Bridgeport, Ala	4	6/25	<.2	<.4	0	10
Kentucky Dam, Ky	(b)	6/19	.2	<.8	2	4
	(b)	6/19	.5	<.9	2	12
Tombigbee River:						
Columbus, Miss	4	6/23	.5	<.3	4	11
Verdigris River:						
Norwata, Okla	4	6/30	2.0	1.7	19	7
Big Horn River:						
Hardin, Mont	(b)	7/7	8.8	3.7	49	12
Big Sioux River:						
Sioux Falls, S. Dak	(b)	7/9	1.2	6.5	11	51
Clinch River:						
Kingston, Tenn	(b)	7/7	1.2	.3	14	19
	(b)	7/28	<.3	<.3	0	4
Delaware River:						
Philadelphia, Pa	(b)	7/1	<.2	<.3	1	4
Great Miami River:						
American Materials Bridge, Ohio	(b)	7/16	1.3	1.2	6	5
Liberty Fairfield, Ohio	(b)	7/16	1.0	.5	5	5
Sellers Road, Ohio	(b)	7/16	<.3	3.8	3	4
Kansas River:						
Holliday, Kans	(b)	7/14	12.0	1.6	51	13
	(b)	7/21	<3.3	6.2	53	11
Lake Superior:						
Duluth, Minn	(b)	7/28	<.2	<.3	0	1
Licking River:						
Covington, Ky	(b)	7/17	<.3	1.0	4	5
Missouri River:						
Bismarck, N. Dak	(b)	7/29	.3	1.3	2	12
	(b)	7/22	1.2	3.2	9	11

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1969				
Missouri River:						
Bismarck, N. Dak	(b)	7/15	1.0	1.9	6	12
	(b)	7/8	1.1	3.0	7	13
	(b)	7/1	<.2	2.7	1	11
St. Joseph, Mo	(b)	7/29	2.5	.7	19	13
Yankton, S. Dak	(b)	7/7	6.1	1.8	25	18
North Platte River:						
Henry, Nebr	(b)	7/21	2.4	8.9	8	29
	(b)	7/28	3.8	8.9	13	22
North Red River:						
Grand Forks, N. Dak	(b)	7/9	1.6	3.8	8	48
Ohio River:						
Anderson Ferry, Ohio	(b)	7/17	<.3	2.7	4	6
Cincinnati, Ohio	(b)	7/2	<.2	<1.0	2	4
	(b)	7/16	.9	<.7	3	4
	(b)	7/17	<.3	1.7	3	6
	(b)	7/23	4.2	<.7	15	17
	(b)	7/30	.2	<1.1	4	7
Eldean, Ohio	(b)	7/7	3.4	8.2	19	25
Greenup Dam, Ky	(b)	7/17	<.4	1.1	5	6
Ironton, Ohio	(b)	7/17	1.4	<.7	6	4
Markland Dam, Ky	(b)	7/17	.2	<1.0	0	5
Maysville, Ky	(b)	7/17	<.4	.2	6	4
Meldahl Dam, Ohio	(b)	7/17	.7	<.8	3	7
Miami Fort, Ohio	(b)	7/16	.8	<1.3	3	7
Portsmouth, Ohio	(b)	7/17	.2	<.7	3	10
Platte River:						
Plattsmouth, Nebr	(b)	7/8	10.2	.9	28	28
	(b)	7/1	7.5	.9	42	18
Schuylkill River:						
Philadelphia, Pa	(b)	7/1	.2	<.9	1	6
Scioto River:						
Lucasville, Ohio	(b)	7/17	2.3	5.1	12	20
Susquehanna River:						
Holtwood, Pa	(b)	7/9	.2	.2	1	5
Tennessee River:						
Kentucky Dam, Ky	(b)	7/17	<.2	2.0	1	4
Clinch River:						
Kingston, Tenn	(b)	8/11	.2	.2	0	9
	(b)	8/17	<.2	<.4	0	6
	(b)	8/25	<.2	.2	0	10
Great Miami River:						
Liberty Fairfield, Ohio	(b)	8/20	<.3	.5	2	16
Lost Bridge, Ohio	(b)	8/20	.5	1.6	3	19
Sellars Road, Ohio	(b)	8/20	<.2	<2.0	1	7
Lake Superior:						
Duluth, Minn	(b)	8/25	<.2	<.3	0	2
Licking River:						
Covington, Ky	(b)	8/21	3.3	<.5	11	8
Little Miami River:						
Cincinnati, Ohio	(b)	8/19	.4	.9	4	7
Missouri River:						
Bismarck, N. Dak	(b)	8/5	.3	1.1	6	13
	(b)	8/12	.2	2.9	1	12
	(b)	8/19	<.3	.7	1	17
	(b)	8/26	.6	3.4	5	11
North Platte River:						
Henry, Nebr	(b)	8/4	<1.6	<6.8	8	23
	(b)	8/11	.8	8.1	4	27
	(b)	8/25	.8	8.2	6	21
Ohio River:						
Anderson Ferry, Ohio	(b)	8/21	.3	<.9	1	6
Cincinnati, Ohio	(b)	8/8	<1.0	<4.3	1	3
	(b)	8/13	.4	<.7	1	8
	(b)	8/19	<.2	<1.1	0	5
	(b)	8/27	<.2	<.8	0	8
Greenup Dam, Ky	(b)	8/19	.2	<.9	2	10
Ironton, Ohio	(b)	8/19	.3	<.8	1	6
Louisville Ky	(b)	8/4	<.2	<.9	1	5
Madison, Ind	(b)	8/21	.5	<.8	3	10
Markland Dam, Ky	(b)	8/21	<.3	<.8	2	5
Maysville, Ky	(b)	8/19	1.1	<.9	4	9
Meldahl Dam, Ohio	(b)	8/19	<.2	<1.0	2	16
Miami Fort, Ohio	(b)	8/19	<.3	<1.1	2	8
Portsmouth, Ohio	(b)	8/19	1.1	<.9	4	9
Scioto River:						
Lucasville, Ohio	(b)	8/19	.7	1.6	3	7
South Platte River:						
Julesburg, Colo	(b)	8/25	.6	21.1	9	43
Tennessee River:						
Kentucky Dam, Ky	(b)	8/21	.9	<.8	6	5
Whitewater River:						
Elizabethtown, Ohio	(b)	8/20	<.3	<1.8	1	5
Allegheny River:						
Pittsburgh, Pa	4	9/18	.2	<.7	0	4
	4	9/18	<.2	<.8	1	4

See footnotes at end of table.

Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1969				
Arkansas River:						
Coolidge, Kans	4	9/2	9.1	15.8	12	33
Fort Smith, Ark	4	9/17	1.7	1.5	5	4
Little Rock, Ark	4	9/24	.8	.8	4	11
Pendleton Ferry, Ark	4	9/24	.6	1.4	3	6
Ponca City, Okla	4	9/29	10.4	5.4	16	17
Chattahoochee River:						
Columbus, Ga	4	9/29	.3	<1.5	1	13
Lanett, Ala	4	9/29	1.3	.5	8	7
Clinch River:						
Kingston, Tenn	(b)	9/15	<.3	<.7	2	<1
	(b)	9/22	<.3	<.9	0	7
	(b)	9/29	<.3	.5	0	3
Coosa River:						
Rome, Ga	4	9/25	.2	1.2	4	7
Cuyahoga River:						
Cleveland, Ohio	(b)	9/31	1.6	2.5	4	10
Escambia River:						
Century, Fla	4	9/23	.5	1.3	2	19
Great Miami River:						
American Materials Bridge, Ohio	(b)	9/24	1.4	<3.0	9	8
Liberty Fairfield, Ohio	(b)	9/24	<.3	.9	2	10
Green River:						
Spottsville, Ky	4	9/15	.8	<.5	5	3
Illinois River:						
Peoria, Ill	3	9/10	2.0	.4	8	7
Kanawha River:						
Winfield Dam, W. Va	4	9/18	<.2	.4	1	4
Lake Erie:						
Buffalo, N.Y	4	9/17	1.1	.2	5	6
	4	9/24	<.2	.5	0	2
Lake Michigan:						
Milwaukee, Wis	4	9/8	<.2	.5	0	3
Lake Superior:						
Duluth, Minn	(b)	9/29	<.2	<.2	0	3
Licking River:						
Covington, Ky	(b)	9/25	<.3	<1.4	1	6
Little Miami River:						
Cincinnati, Ohio	(b)	9/24	1.2	<1.7	6	5
Maumee River:						
Toledo, Ohio	4	9/24	.5	.8	3	8
Mississippi River:						
Lock and Dam, Minn	(b)	9/17	.3	.9	2	10
Cape Girardeau, Mo	3	9/2	4.4	<1.5	23	4
Dubuque, Iowa	3	9/2	.4	1.3	3	8
West Memphis, Ark	4	9/29	3.0	1.6	3	9
Vicksburg, Miss	4	9/22	1.0	.3	2	2
	4	9/25	4.6	1.1	4	5
Missouri River:						
Bismarck, N. Dak	(b)	9/26	<.3	2.9	2	12
St. Joseph, Mo	(b)	9/23	2.2	2.0	9	15
Monongahela River:						
Pittsburgh, Pa	4	9/18	.2	.2	1	6
	4	9/18	<.2	1.4	0	9
North Platte River:						
Henry, Nebr	(b)	9/8	.5	13.0	5	27
North Red River:						
Grand Forks, N. Dak	(b)	9/3	.3	3.8	3	20
Ohio River:						
Anderson Ferry, Ohio	(b)	9/25	<.3	<1.0	1	6
Boyd County, Ky	4	9/17	1.5	.2	6	5
Cane Run, Ky	(b)	9/17	<.3	.5	2	5
Cincinnati, Ohio	(b)	9/4	<.3	<.8	1	3
	(b)	9/24	<.2	<1.6	1	6
	(b)	9/17	<.3	<1.0	1	5
	(b)	9/24	.4	<1.2	2	5
East Liverpool, Ohio	4	9/15	<.2	.3	0	7
Eldean, Ohio	(b)	9/24	<.3	<1.8	3	9
Gallipolis, Ohio	4	9/17	<.3	<1.4	2	7
Greenup Dam, Ky	(b)	9/24	.9	<2.1	3	6
Ironton, Ohio	(b)	9/24	<.3	.3	3	5
Kyger Creek, W. Va	4	9/17	.5	.6	2	5
Louisville, Ky	4	9/17	<.3	.5	1	10
Marietta, Ohio	4	9/18	.5	<1.1	2	9
Markland Dam, Ky	(b)	9/25	.5	<1.1	1	8
Meldahl Dam, Ohio	(b)	9/30	<.3	<.6	1	4
New Martinsville, Ohio	4	9/16	.4	<.9	1	6
Old Lock #19, W. Va	4	9/18	.6	1.3	1	6
Portsmouth, Ohio	(b)	9/24	.2	.4	1	5
South Heights, Pa	4	9/18	.2	.7	1	5
Warwood, W. Va	4	9/15	.3	<.9	0	7
Red River:						
Dennison, Tex	4	9/29	.2	.3	1	14
Index, Ark	4	9/24	.2	1.5	1	8

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1969				
Rio Grande:						
Brownsville, Tex	4	9/29	0.5	1.4	3	17
El Paso, Tex	4	9/8	3.7	.4	6	8
Laredo, Tex	4	9/29	.7	3.8	2	4
Sabine River:						
Ruliff, Tex	4	9/23	.2	<.2	1	6
St. Lawrence River:						
Massena, N.Y	1	9/29	<.2	<.6	0	6
South Platte River:						
Julesburg, Colo	(b)	9/8	<.2	21.3	3	48
Tennessee River:						
Bridgeport, Ala	4	9/17	<.3	<1.5	3	17
Kentucky Dam, Ky	(b)	9/25	.3	<.9	1	7
Trinity River:						
Livingston, Tex	4	9/25	<.2	.9	1	11
Tombigbee River:						
Columbus, Miss	4	9/22	.3	.2	2	5
Verdigris River:						
Norwata, Okla	4	9/29	1.0	1.1	2	3
Whitewater River:						
Elizabethtown, Ohio	(b)	9/24	<.3	<2.0	1	4
Arkansas River:						
Fort Smith, Ark	3	10/22	2.7	.2	3	0
Little Rock, Ark	3	10/29	1.6	6.6	2	2
Pendleton Ferry, Ark	3	10/29	2.2	5.0	2	11
Clinch River:						
Kingston, Tenn	(b)	10/13	<.2	1.0	1	8
	(b)	10/20	<.3	<.7	0	8
Delaware River:						
Philadelphia, Pa	3	10/2	.3	<.3	1	4
Great Miami River:						
American Materials Bridge, Ohio	(b)	10/22	.3	.7	1	11
Liberty Fairfield, Ohio	(b)	10/22	<.2	.4	0	6
Sellers Road, Ohio	(b)	10/22	.3	.8	2	6
Lake Superior:						
Duluth, Minn	(b)	10/27	<.2	<.4	2	4
Licking River:						
Covington, Ky	(b)	10/22	<.2	<.7	1	7
Little Miami River:						
Cincinnati, Ohio	(b)	10/22	.2	1.3	3	6
Missouri River:						
St. Joseph, Mo	(b)	10/21	3.1	1.8	3	28
North Red River:						
Grand Forks, N. Dak	(b)	10/8	.4	1.3	2	22
Ohio River:						
Cincinnati, Ohio	(b)	10/1	.3	.5	0	5
	(b)	10/8	<.2	.5	0	1
	(b)	10/15	.2	.2	0	2
	(b)	10/22	.2	.7	0	1
	(b)	10/22	.2	.2	1	4
	(b)	10/29	.4	<.5	0	0
Eldean, Ohio	(b)	10/22	<.2	2.8	2	12
Greenup Dam, Ky	(b)	10/22	.4	<2.1	2	5
Ironton, Ohio	(b)	10/22	.5	<1.7	1	6
Markland Dam, Ky	(b)	10/22	.4	.7	2	3
Maysville, Ky	(b)	10/22	1.1	.2	4	5
Meldahl Dam, Ohio	(b)	10/22	.4	.2	1	6
Miami Fort, Ohio	(b)	10/22	.3	.3	1	6
Portsmouth, Ohio	(b)	10/22	.2	.4	1	7
Platte River:						
Plattsmouth, Neb	4	10/21	<.3	12.0	2	27
St. Lawrence River:						
Massena, N.Y	(b)	10/13	<.3	<.8	0	3
	(b)	10/20	<.3	.7	0	3
	(b)	10/22	.2	.2	1	9
	(b)	10/27	<.3	.5	0	1
St. Mary River:						
Saulte St. Marie, Mich	(b)	10/6	<.2	6.8	0	2
Schuylkill River:						
Philadelphia, Pa	3	10/3	<.2	.2	0	7
Tennessee River:						
Kentucky Dam, Ky	(b)	10/22	.7	.9	0	6
Whitewater River:						
Elizabethtown, Ohio	(b)	10/22	<.2	.4	2	9
Clinch River:						
Kingston, Tenn	(b)	11/10	<.3	<.7	2	2
	(b)	11/23	<.3	<.5	1	0
	(b)	11/17	.3	.2	0	1
Great Miami River:						
American Materials Bridge, Ohio	(b)	11/25	.8	<1.5	2	3
Liberty Fairfield, Ohio	(b)	11/25	.9	<2.4	4	2
Lost Bridge, Ohio	(b)	11/25	1.5	<2.1	2	2
Sellars Road, Ohio	(b)	11/25	<.3	<2.3	0	2

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency ª	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1969				
Licking River:						
Covington, Ky	(b)	11/24	1.1	<1.7	4	<3
Little Miami:						
Cincinnati, Ohio	(b)	11/24	.7	1.0	4	4
Missouri River:						
Bismarck, N. Dak	(b)	11/30	.9	.8	1	0
North Red River:						
Grand Forks, N. Dak	(b)	11/5	<.2	1.2	0	10
Ohio River:						
Cairo, Ill	(b)	11/24	1.0	<1.1	1	1
Cincinnati, Ohio	(b)	11/5	<.2	.4	1	<3
	(b)	11/12	<.3	.4	0	18
	(b)	11/24	.3	<1.9	1	10
	(b)	11/26	.5	.3	4	8
	(b)	11/19	.4	<.7	2	9
Eldean, Ohio	(b)	11/25	.7	<1.5	3	5
Greenup Dam, Ky	(b)	11/24	.6	.4	1	4
Ironton, Ohio	(b)	11/24	.6	.3	3	7
Madison, Ind	(b)	11/25	.4	<2.3	1	2
Markland Dam, Ky	(b)	11/24	.7	.3	4	8
		11/25	.4	<1.9	0	<3
Maysville, Ky	(b)	11/24	.4	.6	3	7
Miami Fort, Ohio	(b)	11/25	.8	<4.4	2	12
Portsmouth, Ohio	(b)	11/24	.7	1.0	3	8
Potomac River:						
Williamsport, Md	(b)	11/30	.2	.6	1	1
St. Lawrence River:						
Massena, N. Y	(b)	11/3	<.2	<.8	0	12
	(b)	11/10	.3	.7	4	9
	(b)	11/17	.2	.5	2	11
	(b)	11/24	<.3	<1.2	3	16
Tennessee River:						
Kentucky Dam, Ky	(b)	11/25	.7	<.9	1	1
Whitewater River:						
Elizabethtown, Ohio	(b)	11/25	.6	1.1	2	2
Allegheny River:						
Pittsburgh, Pa	4	12/31	<.2	.2	3	10
	4	12/31	.2	.4	0	<2
Arkansas River:						
Ponca City, Okla	4	12/29	2.9	4.2	4	2
Big Sandy River:						
Big Sandy, W. Va	4	12/31	<.2	1.0	17	46
Big Sioux River:						
Sioux Falls, S. Dak	(b)	12/12	.4	1.4	0	<5
Chattahoochee River:						
Columbus, Ga	4	12/29	<.2	.2	2	0
Lanett, Ala	4	12/2	.6	.2	0	0
Clinch River:						
Kingston, Tenn	(b)	12/8	.2	.2	0	0
	(b)	12/1	<.3	<.4	0	0
	(b)	12/15	<.3	.2	0	0
	(b)	12/22	.2	<.4	6	14
	(b)	12/29	.5	.8	8	7
Coosa River:						
Rome, Ga	4	12/17	.3	.2	0	0
Cuyahoga River:						
Cleveland, Ohio	4	12/31	.6	2.3	20	29
Delaware River:						
Mastens Creek, Pa	(b)	12/9	<.2	<.4	0	0
Escambia River:						
Century, Fla	4	12/31	.3	.3	0	0
Great Miami River:						
American Materials Bridge, Ohio	(b)	12/10	.9	.9	2	<1
Liberty Fairfield, Ohio	(b)	12/10	.8	.6	1	<1
Lost Bridge, Ohio	(b)	12/10	3.1	.9	16	8
Sellars Road, Ohio	(b)	12/10	1.1	.8	0	3
Kanawha River:						
Mason County, W. Va	4	12/31	<.3	<.8	5	10
Winfield Dam, W. Va	4	12/31	.3	.3	0	<1
Kentucky River:						
Lock #1, Ky	5	12/17	1.4	.9	1	1
Lake Erie:						
Buffalo, N. Y	4	12/17	.6	.6	19	28
Licking River:						
Covington, Ky	(b)	12/10	1.0	.4	2	1
Little Miami River:						
Cincinnati, Ohio	(b)	12/10	.2	.6	0	2
Maumee River:						
Toledo, Ohio	(b)	12/31	1.0	.9	22	25
Mississippi River:						
Lock and Dam, Minn	(b)	12/11	.3	.6	0	1
Burlington, Iowa	(b)	12/10	.3	.5	0	<1
	(b)	12/25	.6	1.0	0	<1
West Memphis, Ark	4	12/23	1.5	.4	0	0
Vicksburg, Miss	4	12/29	4.6	.9	3	0

See footnotes at end of table.

Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1969				
Missouri River:						
Omaha, Nebr	4	12/31	2.6	6.8	4	20
Yankton, S. Dak	(b)	12/12	<.2	6.8	0	<6
Williston N. Dak	4	12/22	5.8	15.5	5	18
Monongahela River:						
Pittsburgh, Pa	4	12/31	<.3	7.7	6	25
	4	12/31	<.3	<1.1	4	6
North Platte River:						
Henry, Nebr	(b)	12/1	.6	35.2	20	125
North Red River:						
Grand Forks, N. Dak	(b)	12/3	.3	1.2	0	<
	4	12/31	.4	.8	0	<1
Ohio River:						
Addison, Ohio	4	12/31	<.3	<1.3	2	10
Anderson Ferry, Ohio	(b)	12/11	.5	.3	0	<3
Boyd County, Ky	4	12/31	<.3	.2	4	17
Cairo, Ill	(b)	12/8	.7	.3	0	<1
Cane Run, Ky	4	12/16	1.5	5.1	0	2
Cincinnati, Ohio	(b)	12/3	.2	.5	0	<3
	(b)	12/10	.3	<1.6	0	13
	(b)	12/10	.4	.5	0	<1
	(b)	12/17	3.7	.5	1	<1
	(b)	12/24	.6	<1.0	0	<1
	(b)	12/31	.9	.5	0	<1
East Liverpool, Ohio	4	12/31	.2	.2	5	8
Eldean, Ohio	(b)	12/10	.6	2.3	0	<3
Evansville, Ind	4	12/17	.6	.8	0	<1
Gallipolis, Ohio	4	12/31	.2	<1.4	2	9
Greenup Dam, Ky	(b)	12/10	.3	.4	0	<2
Ironton, Ohio	(b)	12/10	.2	.3	0	<1
Kyger Creek, W. Va	4	12/31	.4	.8	0	<3
Louisville, Ky	4	12/16	.4	1.1	0	<3
Madison, Ind	(b)	12/11	.3	.5	0	<3
Marietta, Ohio	4	12/31	.3	<1.8	0	<2
Markland Dam, Ky	(b)	12/10	.4	.6	0	1
Maysville, Ky	(b)	12/10	<.3	<.9	0	<1
Meldahl Dam, Ohio	(b)	12/10	.7	<1.0	0	<1
Miami Fort, Ohio	(b)	12/10	.6	.3	0	<1
Old Lock #19, W. Va	4	12/31	.5	.3	4	9
	4	12/31	.3	<.4	4	3
Portsmouth, Ohio	(b)	12/10	.5	.4	0	<1
South Heights, Pa	4	12/31	<.2	<1.3	5	15
Warwood, W. Va	4	12/31	<.2	.4	3	12
Platte River:						
Plattsmouth, Nebr	4	12/31	1.8	13.3	12	39
Potomac River:						
Williamsport, Md	(b)	12/29	.2	.2	0	0
Red River:						
Dennison, Tex	4	12/29	<.3	.3	0	0
Index, Ark	4	12/28	2.3	.4	1	0
Rio Grande:						
Brownsville, Tex	4	12/15	.6	1.6	0	<6
Laredo, Tex	4	12/29	1.2	2.7	0	<4
Sabine River:						
Ruliff, Tex	4	12/30	.9	.2	0	1
St. Clair River:						
Port Huron, Mich	(b)	12/31	<.3	<1.4	0	<2
St. Lawrence River:						
Massena, N.Y	(b)	12/1	.2	<.9	0	<1
	(b)	12/8	.2	<.9	0	<1
South Platte River:						
Julesburg, Colo	(b)	12/31	3.1	1.2	13	57
Tennessee River:						
Bridgeport, Ala	4	12/12	<.2	.4	0	2
Kentucky Dam, Ky	(b)	12/11	.9	.5	1	<1
Trinity River:						
Livingston, Tex	4	12/10	.7	.7	0	<1
Tombigbee River:						
Coumbus, Miss	4	12/22	1.4	.2	3	1
Verdigris River:						
Norwata, Okla	4	12/29	1.5	2.1	0	1
Wabash River:						
New Harmony, Ohio	4	12/17	1.4	.9	1	0
Whitewater River:						
Elizabethtown, Ohio	(b)	12/10	.5	1.3	1	<4

See footnotes at end of table.

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Table 1 Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Clinch River:						
Kingston, Tenn	(b)	1/12	0.3	0.7	7	9
	(b)	1/19	.3	1.1	5	15
	(b)	1/26	.4	.3	56	82
Licking River:						
Covington, Ky	(b)	1/14	<.2	.4	0	2
Little Miami River:						
Cincinnati, Ohio	(b)	1/14	.5	1.2	3	3
Mississippi River:						
Burlington, Iowa	3	1/14	.2	1.2	3	13
Ohio River:						
Cincinnati, Ohio	(b)	1/7	4.0	.3	4	2
	(b)	1/14	.2	<.3	0	0
	(b)	1/14	.4	.3	1	1
	(b)	1/22	.5	.4	4	5
	(b)	1/28	.4	<.4	8	7
Greenup Dam, Ky	(b)	1/14	<.6	.3	5	3
Ironton, Ohio	(b)	1/14	.6	.4	1	2
Markland Dam, Ky	(b)	1/14	1.3	.5	1	1
Maysville, Ky	(b)	1/14	1.0	.5	3	1
Meldahl Dam, Ohio	(b)	1/14	1.0	.4	4	1
Miami Fort, Ohio	(b)	1/14	1.5	.5	3	1
Portsmouth, Ohio	(b)	1/14	.3	.3	0	1
St. Lawrence River:						
Massena, N Y	(b)	1/5	.3	.5	0	<1
	(b)	1/12	<.2	.4	0	<1
	(b)	1/19	<.3	1.4	3	32
	(b)	1/26	<.2	.6	15	25
St . Mary River:						
Saulte St. Marie, Mich	(b)	1/20	<.3	.4	6	9
Susquehanna River:						
Holtwood, Pa	(b)	1/7	.3	.3	14	25
Tennessee River:						
Kentucky Dam, Ky	(b)	1/14	4.1	.5	7	2
Great Miami River:						
American Materials Bridge, Ohio	(b)	2/11	1.0	2.0	4	14
Liberty Fairfield, Ohio	(b)	2/11	1.2	3.1	8	25
Lost Bridge, Ohio	(b)	2/11	1.1	3.2	5	13
Sellars Road, Ohio	(b)	2/11	.8	2.4	11	13
Licking River:						
Covington, Ky	(b)	2/12	1.8	.2	8	4
Little Miami River:						
Cincinnati, Ohio	(b)	2/11	1.0	.2	3	5
Mississippi River:						
Burlington, Iowa	3	2/12	.3	.9	3	5
West Memphis, Ark	4	2/16	4.3	.4	13	7
Ohio River:						
Anderson Ferry, Ohio	(b)	2/12	1.7	.2	5	11
Cincinnati, Ohio	(b)	2/11	4.0	.3	9	5
Eldean, Ohio	(b)	2/11	1.2	3.2	9	12
Madison, Idaho	(b)	2/12	1.9	.4	11	7
Markland Dam, Ky	(b)	2/12	2.5	.3	7	5
Maysville, Ky	(b)	2/11	3.8	.5	7	6
Meldahl Dam, Ohio	(b)	2/11	2.3	.3	10	5
Miami Fort, Ohio	(b)	2/11	2.4	.3	8	7
Portsmouth, Ohio	(b)	2/11	2.2	.3	5	4
St. Lawrence River:						
Massena, N.Y	(b)	2/2	.2	1.0	14	26
Tennessee River:						
Kentucky Dam, Ky	(b)	2/12	4.0	.4	21	6
Whitewater River:						
Elizabethtown Ohio	(b)	2/11	1.0	1.6	7	16
Allegheny River:						
Pittsburgh, Pa	4	3/31	<.2	.4	0	3
	4	3/31	1.1	.3	1	2
Arkansas River:						
Ponca City, Okla	4	3/30	.5	1.5	0	<3
Big Sandy River:						
Big Sandy, W. Va	4	3/31	.2	.6	0	4
Chattahoochee River:						
Columbus, Ga	4	3/30	.7	.2	0	2
Lanett, Ala	4	3/31	.4	<.3	0	2
Clinch River:						
Kingston, Tenn	(b)	3/9	.3	<.4	15	28
	(b)	3/16	.3	.4	15	24
	(b)	3/23	.3	.4	21	20
	(b)	3/30	<.2	.4	0	5
Coosa River:						
Rome, Ga	4	3/18	.3	.3	0	1
Cuyahoga River:						
Cleveland, Ohio	4	3/25	.3	2.5	2	10
Escambia River:						
Century, Fla	1	3/21	.5	<.3	1	2

See footnotes at end of table.

Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Guyadotte River:						
Guyadotte, W. Va	4	3/31	0.3	<0.4	0	0
Kanawha River:						
Kanawha, W. Va	4	3/31	.5	.3	0	4
Mason County, W. Va	4	3/31	<.3	.4	0	2
Winfield Dam, W. Va	4	3/31	.3	.4	0	0
Lake Erie:						
Buffalo, N.Y	4	3/25	<.2	<.3	0	1
Licking River:						
Covington, Ky	(b)	3/11	.3	.6	68	73
Maumee River:						
Toledo, Ohio	4	3/23	.4	<.6	1	6
Mississippi River:						
Vicksburg, Miss	4	3/30	2.4	<.3	6	3
Monongahela River:						
Pittsburgh, Pa	4	3/31	<.3	.4	0	2
	4	3/31	<.3	.6	7	13
Ohio River:						
Addison, Ohio	4	3/31	.6	<.6	1	3
Boyd County, Ky	4	3/31	.6	.3	2	5
Cincinnati, Ohio	(b)	3/11	4.7	.3	21	19
	(b)	3/18	1.4	<.5	20	25
	(b)	3/25	.4	.2	0	2
East Liverpool, Ohio	(b)	3/31	<.2	.3	0	4
Evansville, Ind	4	3/26	1.8	<.5	32	19
Gallipolis, Ohio	4	3/31	.8	4.0	3	2
Kyger Creek, W. Va	4	3/31	.8	.3	1	4
Louisville, Ky	4	3/17	9.3	.3	91	23
Marietta, Ohio	4	3/31	<.2	.3	0	2
New Martinsville, Ohio	4	3/31	.8	.3	0	2
Old Lock #19, W. Va	4	3/31	.3	<.5	0	3
South Heights, Pa	4	3/31	<.3	.4	7	15
Red River:						
Dennison, Tex	4	3/30	.2	.3	0	0
Index, Ark	4	3/31	3.1	.6	4	7
Rio Grande:						
Brownsville, Tex	4	3/16	1.9	7.1	4	7
El Paso, Tex	4	3/6	.8	.4	6	0
Laredo, Tex	4	3/30	.2	4.1	0	10
Roanoke River:						
John Kerr Dam, Va	(b)	3/9	<.2	.2	6	8
	(b)	3/16	<.2	.2	13	18
	(b)	3/23	.3	.2	7	12
	(b)	3/31	.3	1.5	0	5
St. Lawrence River:						
Massena, N.Y	(b)	3/9	.2	.5	13	23
	(b)	3/16	<.2	.3	15	25
	(b)	3/23	<.2	.8	13	21
Sabine River:						
Ruliff, Tex	4	3/31	.5	1.0	10	14
Tennessee River:						
Bridgeport, Ala	4	3/18	<.2	.6	0	3
Trinity River:						
Livingston, Tex	4	3/25	1.1	.7	3	9
Tombigbee, River:						
Columbus, Miss	4	3/30	.6	.2	1	2
Verdigris River::						
Norwata, Okla	4	3/30	<.2	4.8	0	29
Clinch, River:						
Kingston, Tenn	(b)	4/13	.4	.9	12	30
	(b)	4/20	<.2	.4	9	19
Great Miami River:						
American Materials Bridge, Ohio	(b)	4/15	.7	1.0	8	24
Liberty Fairfield, Ohio	(b)	4/15	.3	2.7	0	4
Lost Bridge, Ohio	(b)	4/15	1.2	2.8	12	31
Sellars Road, Ohio	(b)	4/15	.5	3.0	0	5
Licking River:						
Covington, Ky	(b)	4/15	.3	.5	0	4
Little Miami River:						
Cincinnati, Ohio	(b)	4/15	.6	.5	3	7
Mississippi River:						
Burlington, Iowa	(b)	4/16	1.4	.9	11	7
North Red River:						
Grand Forks, N. Dak	(b)	4/2	<.2	.7	0	5
	(b)	4/9	3.2	.9	15	15
	(b)	4/17	1.8	2.3	23	30
	(b)	4/22	1.2	4.3	18	44
	(b)	4/29	2.4	4.3	15	35
Ohio River:						
Anderson Ferry, Ohio	(b)	4/15	1.5	.9	12	16
Cincinnati, Ohio	(b)	4/8	18.4	.4	76	11
	(b)	4/15	2.3	.3	7	4
	(b)	4/15	1.1	.4	5	5

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency ᵃ	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Ohio River:						
Cincinnati, Ohio	(b)	4/22	0.6	0.3	8	13
	(b)	4/29	3.9	.6	24	16
Eldean, Ohio	(b)	4/15	.5	2.7	1	4
Greenup, Dam, Ky	(b)	4/15	.8	.3	1	3
Ironton, Ohio	(b)	4/15	.9	.3	2	3
Madison, Ind	(b)	4/15	3.0	.8	8	3
Markland Dam, Ky	(b)	4/15	.7	.3	2	4
Maysville, Ky	(b)	4/15	.8	.3	3	4
Meldahl Dam, Ohio	(b)	4/15	.7	.9	2	2
Miami Fort, Ohio	(b)	4/15	1.2	.3	4	4
Portsmouth, Ohio	(b)	4/15	.7	.3	1	3
Roanoke River:						
John Kerr Dam, Va	(b)	4/6	<.2	.4	0	3
	(b)	4/20	.3	.4	7	14
	(b)	4/27	<.2	<.3	6	6
St. Lawrence River:						
Massena, N.Y	(b)	4/6	.4	.5	5	18
	(b)	4/13	<.2	.4	0	6
	(b)	4/20	.2	.3	7	15
	(b)	4/27	<.2	<.5	4	13
Susquehanna River:						
Holtwood, Pa	(b)	4/1	4.1	.2	30	12
Tennessee River:						
Kentucky Dam, Ky	(b)	4/15	1.2	2.0	3	3
Whitewater River:						
Elizabethtown, Ohio	(b)	4/15	.2	1.2	9	23
Clinch River:						
Kingston, Tenn	(b)	5/18	.2	.4	4	15
		5/25	<.2	.5	<3	3
Great Miami River:						
American Materials Bridge, Ohio	(b)	5/20	1.1	.4	5	14
Liberty Fairfield, Ohio	(b)	5/20	.6	1.5	3	10
Lost Bridge, Ohio	(b)	5/20	1.2	1.6	7	23
Sellars Road, Ohio	(b)	5/20	.8	1.0	5	9
Licking River:						
Covington, Ky	(b)	5/20	6.1	4.3	18	7
Little Miami River:						
Cincinnati, Ohio	(b)	5/20	.2	1.0	4	11
Mississippi River:						
Burlington, Iowa	(b)	5/14	6.0	1.0	35	13
Dubuque, Iowa	(b)	5/13	.4	1.6	12	20
North Red River:						
Grand Forks, N. Dak	(b)	5/7	1.6	3.8	15	38
	(b)	5/20	.4	4.3	3	46
	(b)	5/25	1.6	3.9	12	39
	(b)	5/27	.7	3.2	6	24
Ohio River:						
Anderson Ferry, Ohio	(b)	5/20	1.3	.4	5	5
Cincinnati, Ohio	(b)	5/6	1.3	<.5	10	8
	(b)	5/20	1.2	<.6	10	12
	(b)	5/20	1.1	<.6	7	4
	(b)	5/13	.3	<.6	5	9
	(b)	5/27	.4	.3	<3	8
Eldean, Ohio	(b)	5/20	.6	.3	4	11
Greenup Dam, Ky	(b)	5/20	.4	.4	3	9
Ironton, Ohio	(b)	5/21	1.7	<.8	6	5
Madison, Ind	(b)	5/20	.8	.4	8	7
Markland Dam, Ky	(b)	5/20	1.0	.2	9	7
Maysville, Ky	(b)	5/21	.7	<.8	4	5
Meldahl Dam, Ohio	(b)	5/20	.5	<.7	2	4
Miami Fort, Ohio	(b)	5/20	1.5	.8	7	5
Portsmouth, Ohio	(b)	5/21	.5	.3	9	10
Roanoke River:						
John Kerr Dam, Va	(b)	5/4	<.2	<.3	12	9
	(b)	5/11	.3	<.3	5	9
	(b)	5/18	<.2	<.3	5	8
	(b)	5/25	.2	<.3	<3	4
St. Lawrence River:						
Massena, N.Y	(b)	5/4	<.2	.3	5	10
	(b)	5/11	<.2	.2	6	9
	(b)	5/18	<.2	<.5	5	12
	(b)	5/25	<.2	<.5	2	6
Tennessee River:						
Kentucky Dam, Ky	(b)	5/20	.6	.4	11	4
Whitewater River:						
Elizabethtown, Ohio	(b)	5/20	.2	.3	3	4
Allegheny River:						
Pittsburgh, Pa	4	6/30	<.3	<.5	1	3
	4	6/30	<.2	<.5	0	5
	4	6/30	<.3	<.5	1	5
Alpheus Creek:						
Twin Falls, Ind	(b)	6/9	.2	1.5	0	13

See footnotes at end of table.

Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Arkansas River:						
Ponca City, Okla	4	6/30	1.8	2.6	41	19
Big Sandy River:						
Big Sandy, W. Va	4	6/30	.2	<.8	2	5
Big Sioux River:						
Sioux Falls, S. Dak	4	6/30	2.9	3.1	22	30
Chattahoochee River:						
Columbus, Ga	4	6/29	<.3	<.3	1	4
Lanett, Ala	4	6/29	<.3	<.3	1	4
Clinch River:						
Kingston, Tenn	(b)	6/2	.2	.2	0	5
	(b)	6/15	<.2	<.5	0	4
	(b)	6/23	<.2	<.3	0	6
	(b)	6/29	<.2	<.4	0	3
Coosa River:						
Rome, Ga	4	6/10	<.3	<.3	2	3
Cuyahoga River:						
Cleveland, Ohio	4	6/24	.4	4.3	6	23
Detroit River:						
Detroit, Mich	4	6/29	<.2	<.5	1	4
Great Miami River:						
American Materials Bridge, Ohio	(b)	6/17	.3	.6	4	12
Liberty Fairfield, Ohio	(b)	6/17	.3	.5	3	10
Sellars Road, Ohio	(b)	6/17	.3	.4	4	12
Green River:						
Spottsville, Ky	5	6/16	1.7	.3	6	6
Guyadotte River:						
Guyadotte, W. Va	4	6/30	<.3	<.8	0	6
Kanawha River:						
Mason County, W. Va	4	6/30	<.2	<.5	1	4
Winfield Dam, W. Va	4	6/30	<.3	<.6	1	3
Lake Erie:						
Buffalo, N.Y	4	6/24	<.2	<.5	1	6
Lake Superior:						
Duluth, Minn	(b)	6/1	<.2	.2	0	1
	5	6/1	.2	<.2	1	4
Licking River:						
Covington, Ky	(b)	6/17	1.1	.2	8	10
Little Miami River:						
Cincinnati, Ohio	(b)	6/17	.5	.5	10	19
Maumee River:						
Toledo, Ohio	4	6/24	.8	.9	8	11
Mississippi River:						
Lock and Dam, Minn	(b)	6/26	<.2	1.2	3	14
West Memphis, Ark	4	6/15	7.8	1.1	29	7
Vicksburg, Miss	4	6/29	2.2	<.4	14	7
Missouri River:						
Bismarck, N. Dak	4	6/29	1.6	1.8	10	15
Omaha, Nebr	4	6/30	2.8	3.6	11	15
St. Louis, Mo	4	6/23	3.3	2.4	20	30
Yankton, S. Dak	4	6/30	<.2	3.7	2	17
Monongahela River:						
Pittsburgh, Pa	4	6/30	<.2	<5.0	0	7
Muskingum River:						
Muskingum, Ohio	4	6/30	<.2	<1.2	0	6
North Platte River:						
Henry, Nebr	4	6/27	.4	14.3	4	34
North Red River:						
Grand Forks, N. Dak	(b)	6/10	2.4	1.4	14	25
	(b)	6/18	8.4	.3	62	17
	4	6/30	3.4	4.2	47	38
Ohio River:						
Addison, Ohio	4	6/30	.8	<.7	4	7
Beaver, Pa	4	6/30	<.3	<.9	1	12
Boyd County, Ky	4	6/30	<.2	<.8	1	5
Cane Run, Ky	4	6/15	1.5	.2	8	6
Cincinnati, Ohio	(b)	6/3	.2	.7	<3	7
	(b)	6/10	.3	.5	1	6
	(b)	6/16	<.2	<.7	1	6
	(b)	6/17	.5	.6	3	15
	(b)	6/24	.3	<.9	1	7
Eldean, Ohio	(b)	6/17	.6	1.8	5	8
Evansville, Ind	4	6/17	1.1	.3	12	7
Gallipolis, Ohio	4	6/30	<.3	<.7	3	6
Hancock, W. Va	4	6/30	<.2	<.6	0	5
Kyger Creek, W. Va	4	6/30	<1.1	<3.2	0	6
Louisville, Ky	4	6/15	.5	.4	4	7
Marietta, Ohio	4	6/30	<.2	<.8	0	6
Maysville, Ky	(b)	6/17	.9	<.5	5	7
Meldahl Dam, Ohio	(b)	6/17	.3	1.4	1	9
Miami Fort, Ohio	(b)	6/17	.7	<.5	4	5
New Martinsville, Ohio	4	6/30	<.3	<.9	1	5
Old Lock #19, W. Va	4	6/30	<.2	<.8	1	6
Portsmouth, Ohio	(b)	6/17	.5	<1.3	3	6

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi /liter)		Gross beta radioactivity (pCi /liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Ohio River:						
South Heights, Pa	4	6/30	<0.3	<0.4	0	4
Warwood, W. Va	4	6/30	.3	<.6	1	5
Platte River:						
Plattsmouth, Nebr	4	6/30	5.3	10.5	35	27
Potomac River:						
Williamsport, Md	(b)	6/1	<.2	<.6	0	4
	4	6/30	<.3	.5	0	2
Red River:						
Dennison, Tex	4	6/30	<.3	.6	1	16
Index, Ark	4	6/29	3.2	.5	27	12
Rio Grande:						
Brownsville, Tex	4	6/29	<.3	1.5	1	17
El Paso, Tex	4	6/2	.2	2.9	4	25
Laredo, Tex	4	6/29	.6	1.5	4	14
Roanoke River:						
John Kerr Dam, Va	(b)	6/1	<.2	<.2	0	4
	(b)	6/8	.3	<.2	1	4
	(b)	6/15	<.2	<.2	0	4
	(b)	6/22	<.2	<.3	0	3
	(b)	6/29	<.2	<.3	0	4
Sabine River:						
Ruliff, Tex	4	6/30	.6	<.3	4	7
St. Clair River:						
Port Huron, Mich	5	6/29	<.2	<1.5	0	5
St. Lawrence River:						
Massena, N.Y	(b)	6/1	<.2	<.5	3	6
	(b)	6/8	<.2	.6	1	6
	(b)	6/22	<.2	<.6	0	6
St. Mary River:						
Saulte St. Marie, Mich	5	6/30	<.2	.2	0	3
Tennessee River:						
Bridgeport, Ala	4	6/24	<.3	<.4	2	3
Trinity River:						
Livingston, Tex	4	6/24	<.3	<.6	1	9
Tombigbee River:						
Columbus, Miss	4	6/29	.3	<.3	3	5
Verdigris River:						
Norwata, Okla	4	6/29	2.2	<.6	14	9
Whitewater River:						
Elizabethtown, Ohio	(b)	6/17	1.0	<.9	5	10
Wabash River:						
New Harmony, Ohio	4	6/17	5.8	.8	31	10
Allegheny River:						
Pittsburgh, Pa	3	7/8	<.2	.2	0	6
Big Sandy River:						
Big Sandy, W. Va	3	7/15	.4	.7	2	8
Clinch River:						
Kingston, Tenn	(b)	7/6	.4	2.2	7	13
	(b)	7/13	<.1	.2	1	4
	(b)	7/20	<.2	<.3	2	9
Great Miami River:						
American Materials Bridge, Ohio	(b)	7/15	.3	1.0	3	9
Liberty Fairfield, Ohio	(b)	7/15	.4	1.6	2	12
Lost Bridge, Ohio	(b)	7/15	.5	2.1	3	15
Sellars Road, Ohio	(b)	7/15	.2	1.3	2	11
Guyadotte River:						
Guyadotte, W. Va	3	7/15	.3	<.9	0	7
Licking River:						
Covington, Ky	(b)	7/15	.6	.4	2	9
Little Miami River:						
Cincinnati, Ohio	(b)	7/15	1.2	.6	7	9
Mississippi River:						
Burlington, Iowa	(b)	7/16	.4	1.4	3	11
Monongahela River:						
Pittsburgh, Pa	3	7/8	<.2	<.9	0	7
North Red River:						
Grand Forks, N. Dak	(b)	7/2	1.4	2.8	7	25
Ohio River:						
Anderson Ferry, Ohio	(b)	7/15	.2	<.4	2	
Beaver, Pa	3	7/9	.3	<.7	1	15
Boyd County Ky	3	7/15	.2	.2	2	1
Cincinnati, Ohio	(b)	7/1	<.2	<.8	1	8
	(b)	7/8	<.2	.2	1	18
	(b)	7/15	<.3	<.8	1	8
	(b)	7/16	.2	.3	1	9
	(b)	7/22	<.2	<.6	0	6
	(b)	7/29	<.2	<.7	1	9
Eldean, Ohio	(b)	7/15	1.0	2.2	4	12
Greenup Dam, Ky	(b)	7/16	.3	.2	5	12
Hancock, W. Va	3	7/9	.3	<.6	0	6
Ironton, Ohio	(b)	7/16	.3	<.6	3	7
Madison, Ind	(b)	7/15	.2	.4	1	9

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi /liter)		Gross beta radioactivity (pCi /liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Ohio River:						
Markland Dam, Ky	(b)	7/15	<0.2	0.6	2	8
Maysville, Ky	(b)	7/16	.2	.3	2	8
Meldahl Dam, Ohio	(b)	7/16	.2	<.7	2	8
Miami Fort, Ohio	(b)	7/15	.7	.8	3	14
Portsmouth, Ohio	(b)	7/16	.2	.5	1	7
South Heights, Pa	3	7/6	<.2	<.6	0	6
Roanoke River:						
John Kerr Dam, Va	(b)	7/6	<.3	<.3	0	3
	(b)	7/13	<.2	.2	0	4
	(b)	7/20	.3	.2	1	3
	(b)	7/27	.2	<.2	1	4
St. Lawrence River:						
Massena, N. Y	(b)	7/20	<.3	<.6	3	7
	(b)	7/13	<.2	<.4	1	7
	(b)	7/27	<.2	.5	2	13
Susquehanna River:						
Holtwood, Pa	(b)	7/1	.5	.2	2	6
Tennessee River:						
Kentucky Dam, Ky	(b)	7/15	<.2	.4	2	9
Whitewater River:						
Elizabethtown, Ohio	(b)	7/15	.4	.6	7	16
Yellowstone River:						
Sidney, Mont	(b)	7/7	<.3	1.8	0	10
Clinch River:						
Kingston, Tenn	(b)	8/17	.3	.2	2	10
	(b)	8/24	<.2	.4	1	5
	(b)	8/31	.2	.2	1	5
Mississippi River:						
Cape Girardeau, Mo	(b)	8/13	3.0	1.3	11	14
North Red River:						
Grand Forks, N. Dak	(b)	8/10	.8	2.6	5	29
		8/20	.6	2.7	5	32
Ohio River:						
Cincinnati, Ohio	(b)	8/5	<.2	.2	2	18
	(b)	8/12	<.2	.6	2	17
	(b)	8/19	<.2	<.8	1	9
	(b)	8/19	<.2	.4	1	11
	(b)	8/26	.3	.5	3	14
Roanoke River:						
John Kerr Dam, Va	(b)	8/3	<.2	<.2	1	4
	(b)	8/3	<.2	<.2	1	6
	(b)	8/10	.2	<.2	3	8
	(b)	8/17	.3	<.2	3	6
	(b)	8/24	1.2	.2	7	6
	(b)	8/31	<.2	<.2	2	3
	(b)	8/31	<.2	<.2	1	4
Allegheny River:						
Pittsburgh, Pa	4	9/30	<.2	.5	0	3
Arkansas River:						
Ponca City, Okla	4	9/28	2.2	7.9	5	28
Chattahoochee River:						
Columbus, Ga	4	9/28	.5	1.2	0	2
Lanett, Ala	4	9/28	.8	.4	0	1
Clinch River:						
Kingston, Tenn	(b)	9/7	.2	.2	0	3
	(b)	9/14	.2	.2	0	4
	(b)	9/21	.2	.3	3	0
	(b)	9/28	<.2	<.3	4	0
Cuyahoga River:						
Cleveland, Ohio	4	9/30	1.4	7.5	7	19
Great Miami River:						
American Materials Bridge, Ohio	(b)	9/23	.2	1.5	0	10
Liberty Fairfield, Ohio	(b)	9/23	.3	.5	0	6
Lost Bridge, Ohio	(b)	9/23	.9	1.0	3	27
Sellars Road, Ohio	(b)	9/23	<.2	1.7	0	6
Kanawha River:						
Mason County, W. Va	4	9/15	<.2	.6	1	0
Winfield Dam, W. Va	4	9/30	.3	.2	1	1
Lake Erie:						
Buffalo, N.Y	4	9/30	.2	.4	0	3
Licking River:						
Covington, Ky	(b)	9/23	.2	.3	0	8
Little Miami River:						
Cincinnati, Ohio	(b)	9/23	.8	.4	4	4
Maumee River:						
Toledo, Ohio	4	9/30	.5	1.1	0	6
Mississippi River:						
Burlington, Iowa	(b)	9/11	.8	1.2	1	7
West Memphis, Ark	4	9/28	.9	1.8	2	7
Vicksburg, Miss	4	9/28	.6	.3	0	4

See footnotes at end of table.

Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Missouri River:						
Omaha, Nebr	4	9/30	0.2	3.5	0	16
Monongahela River:						
Pittsburgh, Pa	4	9/30	<.2	<.7	0	3
Muskingum River:						
Lock #2, Ohio	4	9/14	.2	.3	2	3
Ohio River:						
Addison, Ohio	4	9/30	<.2	.5	1	5
Anderson Ferry, Ohio	(b)	9/23	.2	.3	1	7
Cane Run, Ky	4	9/15	.2	1.7	0	6
Cincinnati, Ohio	(b)	9/2	<.2	.5	0	4
	(b)	9/9	.2	<.6	0	5
	(b)	9/9	.2	.2	1	2
	(b)	9/16	<.2	.3	0	3
	(b)	9/23	<.2	.4	0	3
	(b)	9/30	.2	.6	0	5
Eldean, Ohio	(b)	9/23	.8	.4	1	7
Evansville, Ind	4	9/24	.5	.8	1	6
Gallipolis, Ohio	3	9/15	<.2	.4	0	4
	3	9/15	<.2	.3	0	0
Greenup Dam, Ky	(b)	9/24	.2	1.4	0	5
Ironton, Ohio	(b)	9/24	<.2	1.4	0	6
Kyger Creek, W. Va	4	9/15	<.2	3	2	1
Louisville, Ky	4	9/15	<.2	1.1	0	7
Madison, Ind	(b)	9/23	.2	3	0	8
Marietta, Ohio	4	9/14	.2	.2	2	2
Markland Dam, Ky	(b)	9/23	.3	.5	0	7
Maysville, Ky	(b)	9/24	.7	.4	0	6
Meldahl Dam, Ohio	(b)	9/24	.2	.3	0	6
Miami Fort, Ohio	(b)	9/23	.5	.3	0	4
New Martinsville, Ohio	3	9/14	<.2	.5	0	5
	3	9/14	<.2	<.7	3	0
Old Lock #19, W. Va	4	9/15	.2	.6	1	1
Portsmouth, Ohio	(b)	9/24	.3	.4	0	5
Warwood, W. Va	4	9/30	.3	<.6	0	6
Platte River:						
Plattsmouth, Nebr	4	9/30	.3	9.4	0	36
Red River:						
Index, Ark	4	9/29	.6	3.8	2	24
Rio Grande:						
Brownsville, Tex	4	9/28	.5	4.8	1	10
El Paso, Tex	4	9/9	16.2	6.1	51	8
Laredo, Tex	4	9/28	1.3	8.4	4	4
Roanoke River:						
John Kerr Dam, Va	(b)	9/8	.3	<.2	0	2
	(b)	9/8	.3	<.2	0	2
	(b)	9/14	.2	.2	0	2
	(b)	9/21	.2	<.2	0	3
	(b)	9/28	.4	<.2	4	0
Sabine River:						
Ruliff, Tex	4	9/29	.7	.3	0	5
St. Lawrence River:						
Massena, N.Y	(b)	9/8	<.1	.3	1	2
	(b)	9/8	<.1	.5	0	4
	(b)	9/14	.4	.2	1	4
	(b)	9/21	<.2	.6	0	5
	(b)	9/28	<.2	.4	0	5
Tennessee River:						
Bridgeport, Ala	4	9/30	.3	.7	0	2
Kentucky Dam, Ky	(b)	9/23	.2	.2	0	4
Trinity River:						
Livingston, Tex	4	9/8	.4	1.0	0	2
Tombigbee River:						
Columbus, Miss	4	9/28	.5	.5	0	2
Verdigris River:						
Norwata, Okla	4	9/28	.7	1.1	2	8
Wabash River:						
New Harmony, Ohio	4	9/24	.9	1.1	3	6
Whitewater River:						
Elizabethtown, Ohio	(b)	9/23	.9	1.4	3	3
Big Horn River:						
Hardin, Mont	(b)	10/2	<.2	4.6	3	37
Clinch River:						
Kingston, Tenn	(b)	10/5	<.2	.2	0	3
	(b)	10/12	<.2	.4	0	3
	(b)	10/19	<.2	.2	0	4
	(b)	10/26	<.2	.4	0	2
Great Miami River:						
American Materials Bridge, Ohio	(b)	10/14	.6	.7	8	10
Liberty Fairfield, Ohio	(b)	10/14	.3	.5	2	11
Lost Bridge, Ohio	(b)	10/14	.9	2.1	6	10
Sellars Road, Ohio	(b)	10/14	.5	2.1	4	12
Licking River:						
Covington, Ky	(b)	10/14	<.3	.5	2	8

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Little Miami River:						
Cincinnati, Ohio	(b)	10/14	1.2	1.6	7	10
Mississippi River:						
Burlington, Iowa	(b)	10/8	.8	.4	3	7
Ohio River:						
Anderson Ferry, Ohio	(b)	10/14	.4	1.0	1	8
Cincinnati, Ohio	(b)	10/7	.6	<.9	1	9
	(b)	10/14	1.4	.3	5	5
	(b)	10/15	.2	.3	2	6
	(b)	10/21	.2	.4	0	7
	(b)	10/19	.2	.3	1	9
	(b)	10/28	.3	.4	0	5
Eldean, Ohio	(b)	10/14	.4	3.0	2	12
Greenup Dam, Ky	(b)	10/15	.4	.7	2	8
Ironton, Ohio	(b)	10/15	.3	.4	1	8
Madison, Ind	(b)	10/14	.4	1.1	1	9
Markland Dam, Ky	(b)	10/14	.6	.4	2	9
Maysville, Ky	(b)	10/15	4.6	.5	12	8
Meldahl Dam, Ohio	(b)	10/15	.2	.3	2	8
Miami Fort, Ohio	(b)	10/14	.4	.4	3	7
Portsmouth, Ohio	(b)	10/15	.4	.3	2	8
Roanoke River:						
John Kerr Dam, Va	(b)	10/5	.3	<.2	0	5
	(b)	10/13	<.2	.2	0	3
	(b)	10/19	<.2	.2	0	3
	(b)	10/25	<.1	.2	0	4
St. Lawrence River:						
Massena, N.Y	(b)	10/5	<.2	<.4	0	6
	(b)	10/19	.3	.3	0	5
	(b)	10/26	.2	.2	1	5
Susquehanna River:						
Holtwood, Pa	(b)	10/7	.4	.4	1	4
Tennessee River:						
Kentucky Dam, Ky	(b)	10/14	2.1	1.1	7	7
Whitewater River:						
Elizabethtown, Ohio	(b)	10/14	.3	.5	2	8
Clinch River:						
Kingston, Tenn	(b)	11/2	<.2	.2	0	9
	(b)	11/9	.3	.9	0	5
	(b)	11/16	.3	.5	0	7
	(b)	11/23	.4	.2	3	5
	(b)	11/20	.4	.5	5	4
Great Miami River:						
American Materials Bridge, Ohio	(b)	11/18	.2	2.0	1	9
Liberty Fairfield, Ohio	(b)	11/18	.4	1.5	2	10
Lost Bridge, Ohio	(b)	11/18	<.2	1.7	1	8
Sellars Road, Ohio	(b)	11/18	.7	1.3	2	9
Licking River:						
Covington, Ky	(b)	11/18	.5	.3	2	3
Little Miami River:						
Cincinnati, Ohio	(b)	11/18	.6	1.1	2	8
Mississippi River:						
Dubuque, Iowa	(b)	11/13	1.9	1.7	5	6
Missouri River:						
St. Joseph, Mo	(b)	11/25	.3	7.7	0	15
Ohio River:						
Anderson Ferry, Ohio	(b)	11/18	1.0	.2	3	7
Cincinnati, Ohio	(b)	11/4	3.4	.2	9	4
	(b)	11/12	1.1	1.2	2	4
	(b)	11/19	.5	.3	3	5
	(b)	11/18	1.7	.6	2	4
	(b)	11/24	1.1	.7	3	4
Eldean, Ohio	(b)	11/18	<.4	.8	2	7
Greenup Dam, Ky	(b)	11/19	.7	.3	2	5
Ironton, Ohio	(b)	11/19	.7	<.5	3	5
Madison, Ind	(b)	11/18	1.3	.2	3	5
Markland Dam, Ky	(b)	11/18	.5	.3	2	7
Maysville, Ky	(b)	11/19	1.4	.2	3	5
Meldahl Dam, Ohio	(b)	11/19	1.0	.2	3	3
Portsmouth, Ohio	(b)	11/19	.6	.3	4	6
Roanoke River:						
John Kerr Dam, Va	(b)	11/2	<.2	.3	0	3
	(b)	11/9	.4	.8	0	4
	(b)	11/16	.5	.4	0	3
	(b)	11/23	.7	.6	1	5
	(b)	11/30	.3	.3	0	5
St. Lawrence River:						
Massena, N.Y	(b)	11/2	<.2	.6	0	5
	(b)	11/15	.9	.8	1	5
	(b)	11/23	.5	.6	0	5
	(b)	11/30	.6	.5	1	6
Tennessee River:						
Kentucky Dam, Ky	(b)	11/18	1.6	.6	5	4

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
		1970				
Whitewater River:						
Elizabethtown, Ohio	(b)	11/18	0.3	1.7	0	6
Allegheny River:						
Pittsburgh, Pa	4	12/14	<.3	.2	3	5
	4	12/16	.3	.3	3	4
Arkansas River:						
Ponca City, Okla	4	12/28	1.9	7.0	7	23
Beaver River:						
Rt. 18 Bridge, Pa	4	12/15	1.0	<.6	4	11
Big Sandy River:						
Big Sandy, W. Va	4	12/16	.6	.4	4	8
Big Sioux River:						
Sioux Falls, S. Dak	4	12/22	.5	1.0	4	28
Clinch River:						
Kingston, Tenn	(b)	12/7	.3	1.3	2	11
	(b)	12/18	.2	.6	2	9
Cuyahoga River:						
Cleveland, Ohio	4	12/30	1.0	4.2	8	23
Detroit River:						
Detroit, Mich	5	12/31	.2	.3	2	6
Great Miami River:						
Lost Bridge, Ohio	(b)	12/16	<.2	.8	3	8
Green River:						
Spottsville, Ky	5	12/16	1.3	1.1	4	9
Guyadotte River:						
Guyadotte, W. Va	4	12/16	.2	.8	2	7
Kanawha River:						
Mason County, W. Va	4	12/15	.4	<.4	3	5
Winfield Dam, W. Va	4	12/16	.7	<.4	4	5
Lake Erie:						
Buffalo, N.Y	4	12/30	.5	.3	5	7
Lake Superior:						
Duluth, Minn	(b)	12/23	.2	.3	2	6
	5	12/31	.3	<.3	0	2
Licking River:						
Covington, Ky	(b)	12/16	.8	<.4	8	10
Little Miami River:						
Cincinnati, Ohio	(b)	12/16	.6	2.0	4	12
Maumee River:						
Toledo, Ohio	4	12/23	.9	1.2	4	13
Mississippi River:						
Lock and Dam, Minn	5	12/31	.2	2.4	3	11
Burlington, Iowa	(b)	12/17	.5	3.7	2	6
West Memphis, Ark	4	12/28	1.9	1.5	8	10
Vicksburg, Miss	4	12/28	2.2	.4	7	5
Missouri River:						
Yankton, S. Dak	4	12/23	1.0	.7	3	16
Monongahela River:						
Pittsburgh, Pa	4	12/14	<.2	.3	2	9
	4	12/14	.5	<.6	2	8
Muskingum River:						
Lock #2, Ohio	(b)	12/14	.3	.6	4	13
Ohio River:						
Addison, Ohio	(b)	12/16	1.4	<.6	6	7
Anderson Ferry, Ohio	(b)	12/16	1.0	<.4	8	6
Boyd County, Ky	4	12/16	.8	<.6	5	7
Cane Run, Ky	4	12/15	.8	.6	6	11
Cincinnati, Ohio	(b)	12/2	.6	.8	3	7
	(b)	12/9	.6	<.5	7	7
	(b)	12/16	1.8	.4	8	5
	(b)	12/17	.8	.2	10	6
	(b)	12/23	7.1	.4	26	8
	(b)	12/30	1.8	.3	9	7
Eldean, Ohio	(b)	12/16	.7	1.6	2	7
Evansville, Ind	4	12/29	2.7	<.6	9	7
Gallipolis, Ohio	(b)	12/15	.7	.3	5	8
Greenup Dam, Ky	(b)	12/17	2.4	.2	7	6
Hancock, W. Va	4	12/15	.3	<.4	5	5
Ironton, Ohio	(b)	12/17	.8	<.4	7	6
Kyger Creek, W. Va	4	12/15	.7	<.6	4	8
Louisville, Ky	4	12/15	.8	.6	3	9
Madison, Ind	(b)	12/16	.9	.2	8	7
Marietta, Ohio	4	12/14	.6	<.6	5	8
Markland Dam, Ky	(b)	12/16	.7	<.4	6	7
Maysville, Ky	(b)	12/17	2.0	.2	10	7
Meldahl Dam, Ohio	(b)	12/17	.4	.5	4	6
Miami Fort, Ohio	(b)	12/16	2.6	.2	10	6
New Martinsville, Ohio	4	12/14	.5	.4	3	7
Old Lock #19, W. Va	4	12/14	.7	<.6	3	7
Portsmouth, Ohio	(b)	12/17	3.9	.2	9	7
South Heights, Pa	4	12/14	.2	<.4	2	6
Warwood, W. Va	4	12/16	<.3	<.5	3	7

See footnotes at end of table.

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Table 1. Gross radioactivity in U.S. surface waters, January 1969-December 1970—continued

River and station	Sampling frequency [a]	Date	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
			Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
Red River:						
Dennison, Tex	4	12/28	0.3	1.2	2	19
Index, Ark	4	12/28	3.1	.8	10	12
Rio Grande:						
Brownsville, Tex	4	12/28	.2	3.1	3	21
El Paso, Tex	4	12/28	.4	2.8	3	18
Laredo, Tex	4	12/28	.4	2.5	4	15
Roanoke River:						
John Kerr Dam, Va	(b)	12/7	.3	.3	1	5
	(b)	12/14	.3	.3	2	6
	(b)	12/21	<.2	<.3	2	6
	(b)	12/28	.2	.3	2	6
Sabine River:						
Ruliff, Tex	4	12/24	2.1	.4	6	7
St. Lawrence River:						
Massena, N.Y	(b)	12/7	.5	.7	4	7
	(b)	12/14	.3	.5	2	8
	(b)	12/21	.2	.5	2	7
	(b)	12/28	.3	.4	2	7
Tennessee River:						
Kentucky Dam, Ky	(b)	12/16	.8	<.5	6	8
Trinity River:						
Livingston, Tex	4	12/31	.9	1.8	5	17
Verdigris River:						
Norwata, Okla	4	12/28	<.3	2.6	3	12
Wabash River:						
New Harmony, Ohio	(b)	12/29	1.1	1.1	6	12
Whitewater River:						
Elizabethtown, Ohio	(b)	12/16	.4	1.0	2	9

[a] Sampling frequency: 1—grab sample; 2—weekly; 3—monthly; 4—quarterly; 5—semiannual; 6—annual.
[b] Sampling frequency not recorded.

Tritium Surveillance Systems, January-March 1973

Office of Radiation Programs
Environmental Protection Agency

The Tritium Surveillance System is an expansion of previous tritium surveillance activities initiated by the Public Health Service and transferred in 1970 to the Office of Radiation Programs, Environmental Protection Agency (EPA). The principal effort in the past related to tritium releases was the Tritium in Surface Water Network. This network was established in 1964 to measure and monitor tritium concentrations in major river systems in the United States and to provide surveillance at surface water stations downstream from selected nuclear facilities. The network consisted of selected stations from the existing water pollution surveillance sampling stations. The final data from this network for January–June 1970, have been published previously (*1*).

Another sampling program of the Public Health Service was a tritium in precipitation program. This project was established in 1967 at selected Radiation Alert Network (RAN) stations covering the United States, including Alaska and Hawaii. The RAN is now operated by the Office of Air Programs of the EPA. The data from this project for July–December 1969 have been published previously (*2*). Due to the increased interest in tritium releases from nuclear facilities and the potential long-term accumulation in the environment, a national system was established to incorporate these projects or networks into one overall system.

Present network

The Tritium Surveillance System consists of 68 quarterly drinking water samples at the RAN stations, precipitation samples collected daily and analyzed monthly from 8 of the RAN stations (figure 1), and quarterly samples at 39 surface water stations (figure 2). The specific locations for the surface water sampling system were determined by examining the water

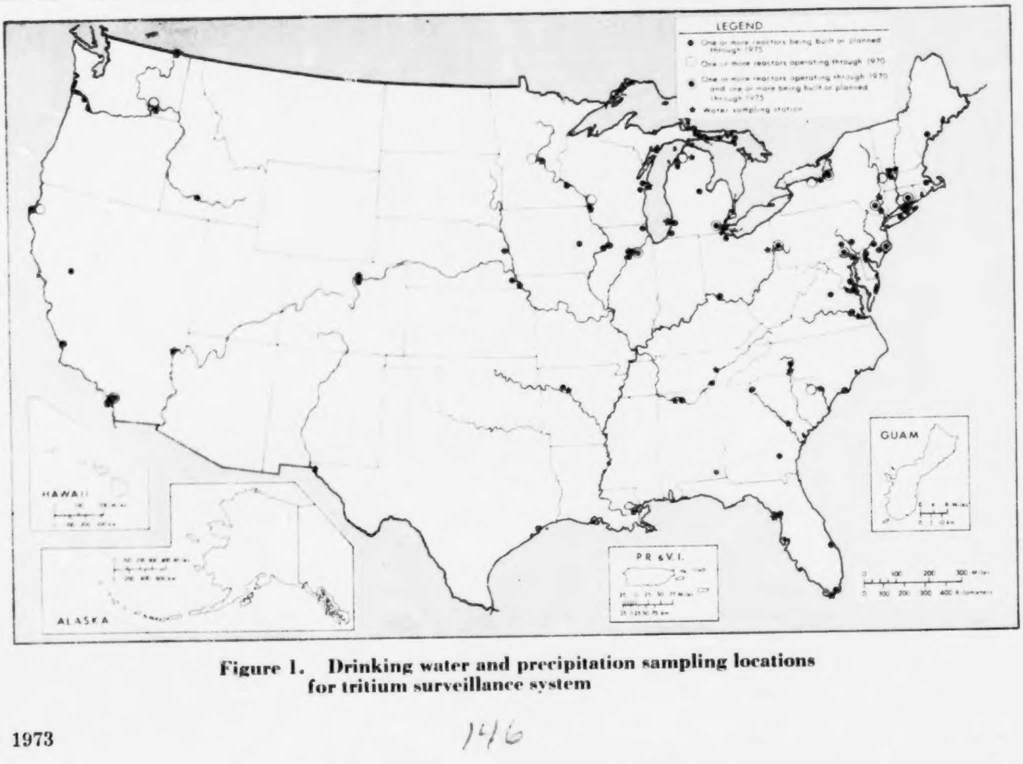
LEGEND
● One or more reactors being built or planned through 1975
○ One or more reactors operating through 1970
● One or more reactors operating through 1970 and one or more being built or planned through 1975
★ Water sampling station
HAWAII
ALASKA
PR & V.I.
GUAM
0 100 200 300 Miles
0 100 200 300 400 Kilometers

Figure 1. Drinking water and precipitation sampling locations for tritium surveillance system

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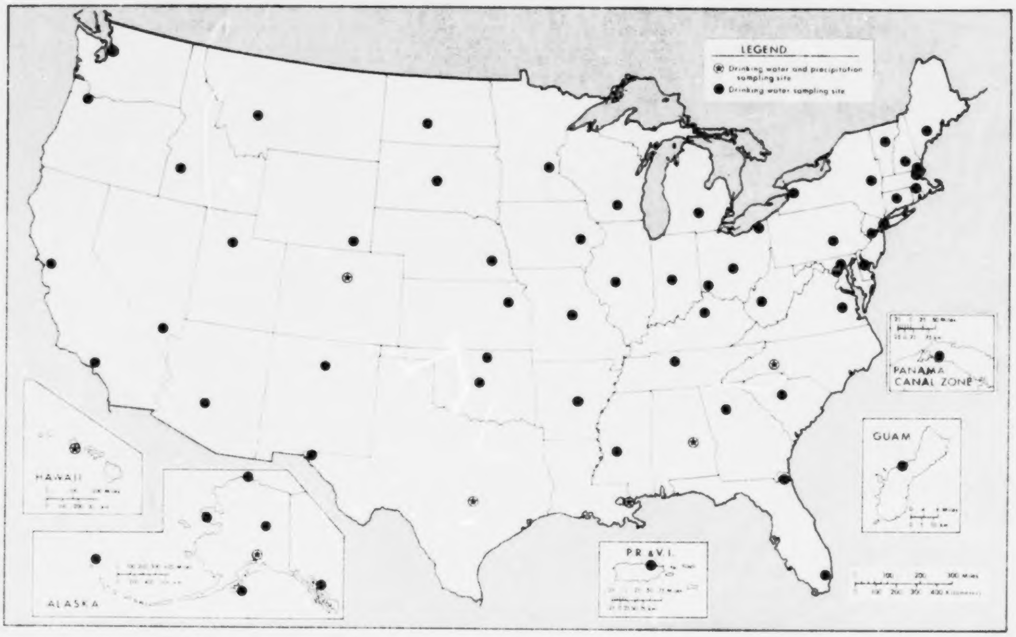

LEGEND
Drinking water and precipitation sampling site
Drinking water sampling site
HAWAII
ALASKA
PR & V.I.
GUAM
PANAMA CANAL ZONE

Figure 2. Surface water sampling locations for tritium surveillance system

drainage areas to assure that a representative sample from a large area or region was obtained, and if possible, incorporating several nuclear facility sites. All nuclear facilities that were operating, being constructed, or planned through 1975 were considered. Consideration was also given to the current surveillance programs of the States that will be involved in the collection of the samples. The surface water samples are collected quarterly either downstream from a nuclear facility or at a background station.

The tap water samples are collected by the RAN operators on a quarterly basis. The precipitation samples are also collected by the RAN operators on a daily basis.

All samples are sent to either the Eastern Environmental Radiation Facility or the National Environmental Research Center—Las Vegas, for analysis. Analytical values which are not statistically significant at the 2-sigma confidence level have been reported as zero.

Results and discussion

Table 1 presents the tritium concentrations in drinking water at the RAN stations for January–March 1973. The average tritium concentration was 0.2 nCi/liter.

In previous articles on the Tritium Surveillance Systems, the reported dose equivalents from tritium in body water have been based on a relationship derived by Moghissi and Porter (*3*). Their relationship assumed a quality factor of 1.7 for tritium beta rays based on a 1966 ICRP recommendation (*4*). Recently the NCRP has recommended a quality factor of 1 for tritium beta rays (*5*) and this recommendation has been adopted for this and subsequent reports. Following the notation adopted by the ICRU (*6*) substitution of a quality factor of 1 in Moghissi and Porter's calculations yields:

$$H\ (\text{mrem/year}) = 0.1C\ (\text{nCi/liter})$$

Table 1. Tritium concentration in tap water, (RAN stations), January-March 1973

Location		Date collected (1973)	Tritium concentration[a] (nCi/liter ± 2σ)[b]
Ala:	Montgomery	1/2	0
Alaska:	Anchorage	1/8	0.7
	Attu Island	1/2	.3
	Fairbanks	2/26	.7
	Juneau	1/1	.3
	Nome	2/15	.5
	Point Barrow	1/28	.8 ±0.3
Ariz:	Phoenix	1/8	.2
Ark:	Little Rock	1/2	0
Calif:	Berkeley	1/2	0
	Los Angeles	1/8	.3
C.Z:	Ancon	2/5	0
Colo:	Denver	1/8	.9
Conn:	Hartford	1/9	0
Del:	Dover	1/5	0
D.C:	Washington	2/12	.2
Fla:	Jacksonville	1/4	0
	Miami	1/8	0
Ga:	Atlanta	1/10	.2
Guam:	Agana	1/2	0
Hawaii:	Honolulu	1/2	0
Idaho:	Boise	1/9	.5
Ill:	Springfield	1/11	.2
Ind:	Indianapolis	NS	
Iowa:	Iowa City	1/4	.6
Kans:	Topeka	1/2	0
Ky:	Frankfort	2/6	0
La:	New Orleans	1/4	.5
Maine:	Augusta	1/8	0
Md:	Baltimore	1/4	.2
Mass:	Lawrence	1/8	.2
	Winchester	1/5	.2
Mich:	Lansing	1/5	0
Minn:	Minneapolis	1/11	.6
Miss:	Jackson	1/5	0
Mo:	Jefferson City	1/3	0
Mont:	Helena	1/11	.8 ± .3
Nebr:	Lincoln	1/22	0
Nev:	Las Vegas	1/4	.9
N.H:	Concord	1/9	.2
N.J:	Trenton	1/4	0
N. Mex:	Sante Fe	1/12	0
N.Y:	Albany	NS	
	Buffalo	1/10	.4
	New York City	1/4	.3
N.C:	Gastonia	1/5	0
N. Dak:	Bismarck	2/26	.8 ± .3
Ohio:	Cincinnati	1/5	.2
	Columbus	1/5	.2
	Painesville	NS	
Okla:	Oklahoma City	1/2	0
Oreg:	Portland	1/5	0
Pa:	Harrisburg	1/9	0
P.R:	San Juan	1/10	0
R.I:	Providence	1/5	0
S.C:	Columbia	1/4	.2
S. Dak:	Pierre	1/2	.9
Tenn:	Nashville	1/5	0
Tex:	Austin	1/4	0
	El Paso	1/3	0
Utah:	Salt Lake City	1/10	.9
Vt:	Barre	1/5	.2
Va:	Richmond	1/4	.3
Wash:	Seattle	1/15	.2
	Spokane	1/2	.3
W. Va:	Charleston	1/4	.2
Wisc:	Madison	1/5	0
Wyo:	Cheyenne	1/3	.8
Average			0.2

[a] The minimum detection limit for all samples was 0.20 nCi/liter. All values equal to or less than 0.20 nCi/liter before rounding have been reported as zero.

[b] The 2σ error for all samples is 0.2 nCi/liter unless otherwise noted.

NS, no sample.

Where H is the dose equivalent rate and C represents the tritium concentration in body water.

Assuming that the concentration of tritium in all water taken into the body is equal to that found in the drinking water and also that the specific activity of tritium in the body is essentially the same as that in the drinking water, then the radiation dose may be estimated.

The highest individual concentration of tritium observed in the drinking water was 0.9 nCi/liter during the first quarter. This corresponds to a dose of 0.09 mrem/a, or less than 0.06 percent of the Federal Radiation Council's Radiation Protection Guide (170 mrem/a) for an average dose to a suitable sample of the exposed population.

The tritium concentrations for the surface water samples are given in table 2. The highest tritium concentration was 10.4 nCi/liter for the quarter. Assuming that the specific activity of tritium in the body is essentially the same as that in surface water, this concentration corresponds to a dose of 1.04 mrem/a, or 0.61 percent of the Radiation Protection Guide.

The monthly analyses for tritium in precipitation samples at the 8 RAN stations are shown in table 3.

REFERENCES

(*1*) BUREAU OF RADIOLOGICAL HEALTH. Tritium in surface water network, January–June 1970. Radiol Health Data Rep 11:638–639 (November 1970).

(*2*) BUREAU OF RADIOLOGICAL HEALTH. Tritium in precipitation (RAN), July–December 1969. Radiol Health Data Rep 11:354–355 (July 1970).

(*3*) MOGHISSI, A. A. and C. R. PORTER. Tritium in surface waters in the United States, 1966. Radiol Health Data Rep 9:337–339 (July 1968).

(*4*) INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. Recommendations of the International Commission on Radiological Protection (Adopted September 17, 1965), ICRP Publication 9 (1969).

(*5*) NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS. Basic radiation protection criteria, NCRP Report No. 39. National Council on Radiation Protection and Measurements, Washington, D.C. 20008 (January 15, 1971).

(*6*) INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Radiation Quantities and Units, ICRU Report No. 19. Washington, D.C. 20014 (July 1972).

Table 2. Tritium concentration in surface water, January-March 1973

Location		Water source	Facility	Collection date (1973)	Concentration[a] (nCi/liter ±2σ)[b]
Ala:	Decatur	Tennessee River	Browns Ferry	1/24	0.2
Ark:	Morrilton	Arkansas River	Arkansas Nuclear	1/12	0
Calif:	Eureka	Humboldt Bay	Humboldt Bay	1/17	0
	San Onofre	Pacific Ocean	San Onofre	NS	
Colo:	Greely	South Platte River	Fort St. Vrain	1/12	.9
Conn:	East Haddam	Connecticut River	Connecticut Yankee & Vermont Yankee	1/19	1.9
	Waterford	Long Island Sound	Millstone	1/19	0
Fla:	Crystal River	Gulf of Mexico	Crystal River	1/26	0
	Homestead	Biscayne Bay	Turkey Point	1/9	0
Idaho:	Buhl	Snake River	National Reactor Testing Station	1/8	.6
Ill:	Moline	Mississippi River	Quad-Cities	1/31	.2
	Morris	Illinois River	Dresden and Argonne	1/19	.2
La:	New Orleans	Mississippi River	(Several)	1/3	.3
Md:	Conowingo	Susquehanna River	Peach Bottom and Three Mile Island	1/9	.2
	Lusby	Chesapeake Bay	Calvert Cliffs	1/30	0
Mass:	Rowe	Deerfield River	Yankee	1/25	2.2
Mich:	Charlevoix	Lake Michigan	Big Rock Point	1/14	0
	Monroe	Lake Erie	Enrico Fermi	1/14	.3
	South Haven	Lake Michigan	Palisades	1/26	1.0
Minn:	Monticello	Mississippi	Monticello	1/11	.7
Nebr:	Rulo	Missouri River	Fort Calhoun and Cooper	1/17	.6
Nev:	Boulder City	Colorado River	Background	1/9	1.0 ± .3
N.J:	Bayside	Delaware River	Salem	1/18	.2
N.Y:	Ossining	Hudson River	Indian Point	1/5	.2
	Oswego	Lake Ontario	Nine Mile Point and R.E. Ginna	1/9	.4
	Poughkeepsie	Hudson River	Background	1/10	0
N.C:	Charlotte	Catawba River	Wm. B. McGuire	1/16	.2
Oreg:	Westport	Columbia River	Rainier and Hanford	NS	
S.C:	Allendale	Savannah River	Savannah River Plant and Oconee	1/2	10.4 ± .3
	Hartsville	Lake Robinson	H. B. Robinson	1/4	2.1
Tenn:	Kingston	Clinch River	Oak Ridge	2/8	2.9
Tex:	El Paso	Rio Grande	Los Alamos	1/3	.4
Vt:	Vernon	Connecticut River	Vermont Yankee	1/5	.2
Va:	Newport News	James River	Surry	[c] 12/20	0
Wash:	Northport	Columbia River	Background	2/26	.6
	Richland	Columbia River	Hanford	1/3	.5
W. Va:	Wheeling	Ohio River	Shippingport	1/8	0
Wisc:	Two Creeks	Lake Michigan	Point Beach and Kewaunee	1/15	.3
	Victory	Mississippi River	LaCrosse and Prairie Island	1/8	.3
Average					0.8

[a] The minimum detection limit for all samples was 0.20 nCi/liter. All values equal to or less than 0.20 nCi/liter before rounding have been reported as zero.
[b] The 2σ error for all samples is 0.2 nCi/liter unless otherwise noted.
[c] Sample collected early.
NS, no sample.

Table 3. Tritium concentration in precipitation from RAN stations, January-March 1973

Location		Tritium concentration[a] (nCi/liter ±2σ)		
		January	February	March
Ala:	Montgomery	0.3	0.0	0.0
Alaska:	Anchorage	.0	NS	NS
Colo:	Denver	.2	NS	.4
Hawaii:	Honolulu	.0	.0	.0
La:	New Orleans	.0	.0	.0
N.C:	Gastonia	.3	.2	.2
Tex:	Austin	.0	.0	.0
Wash:	Seattle	.0	.0	.0

[a] The minimum detection limit for these samples was 0.20 nCi/liter. All values equal to or less than 0.20 nCi/liter before rounding have been reported as zero. The 2 σ error for all samples is 0.2 nCi/liter unless otherwise noted.
NS, no sample.

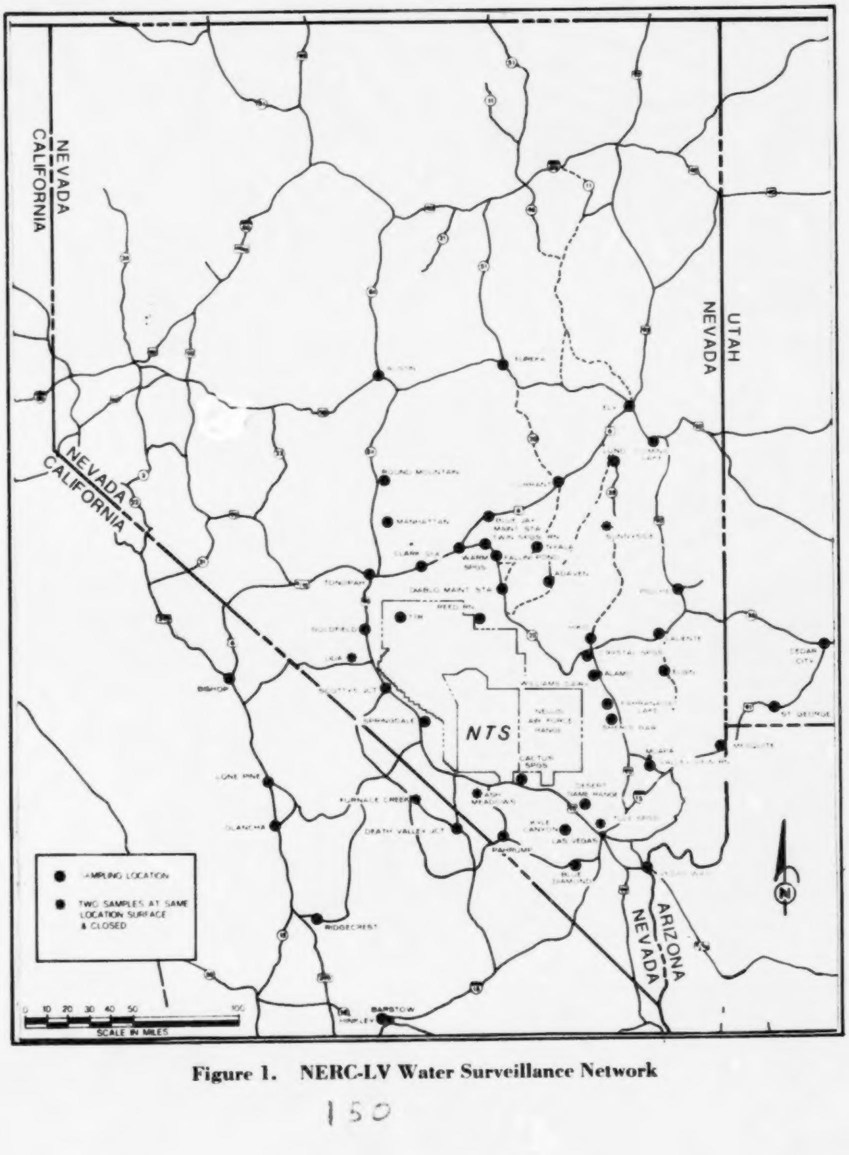
Other coverage in *Radiation Data and Reports:*

Period	Issue
January–March 1972	August 1972
April–June 1972	January 1973
July–September 1972	February 1973
October–December 1972	May 1973

Water Surveillance Programs,[1] January 1973

National Environmental Research Center—
Las Vegas, Environmental Protection Agency

The National Environmental Research Center—Las Vegas (NERC-LV) is responsible for conducting a radiological safety and environmental surveillance program in the offsite area surrounding the Nevada Test Site (NTS) in support of nuclear testing conducted by the U.S. Atomic Energy Commission (AEC). When required, additional surveillance programs are established at locations other than around the


NEVADA
CALIFORNIA
UTAH
NEVADA
ARIZONA
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AUSTIN
EUREKA
ELY
LUND
ROUND MOUNTAIN
CURRANT
MANHATTAN
BLUE JAY
MAINT. STA.
TWIN SPGS RN
NYALA
CLARK STA
WARM SPGS
FALLON POND
ADAVEN
SUNNYSIDE
TONOPAH
DIABLO MAINT. STA
PIOCHE
REED RN
TTR
GOLDFIELD
HIKO
CALIENTE
CEDAR CITY
LIDA
CRYSTAL SPGS
ALAMO
ELGIN
BISHOP
SCOTTYS JCT
WILLIAMS RANCH
PAHRANAGAT LAKE
SHERIS RAN
ST GEORGE
SPRINGDALE
NTS
NELLIS AIR FORCE RANGE
MESQUITE
MOAPA
CACTUS SPGS
LONE PINE
FURNACE CREEK
ASH MEADOWS
DESERT GAME RANGE
OLANCHA
DEATH VALLEY JCT
KYLE CANYON
LAS VEGAS
PAHRUMP
BLUE DIAMOND
RIDGECREST
BARSTOW
HINKLEY
● SAMPLING LOCATION
● TWO SAMPLES AT SAME LOCATION SURFACE & CLOSED
0 10 20 30 40 50 100
SCALE IN MILES
N

Figure 1. NERC-LV Water Surveillance Network

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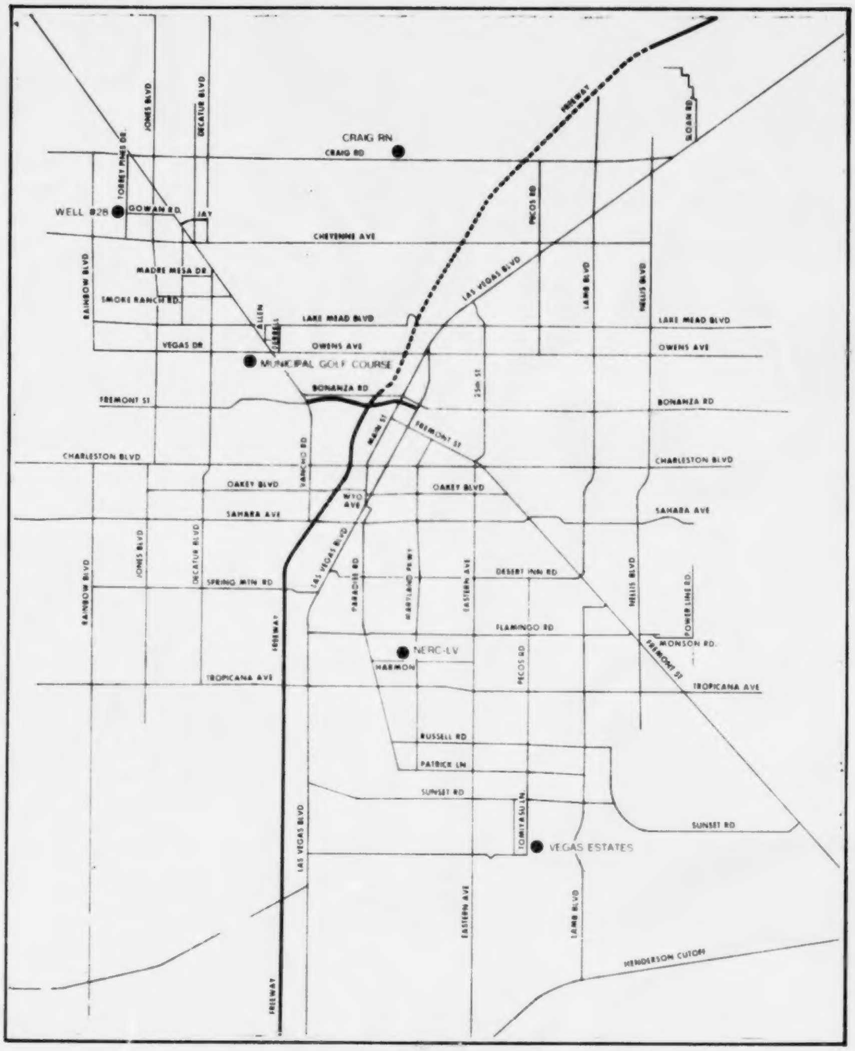
[1] This network is operated under a Memorandum of Understanding (No. AT (26-1)-539) with the Nevada Operations Office, U.S. Atomic Energy Commission, Las Vegas, Nev.


CRAIG RN
CRAIG RD
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JAY
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TORREY PINES DR.
JONES BLVD
DECATUR BLVD
RAINBOW BLVD
MADRE MESA DR
SMOKE RANCH RD.
ALLEN
LAKE MEAD BLVD
VEGAS DR
OWENS AVE
MUNICIPAL GOLF COURSE
BONANZA RD
FREMONT ST
CHARLESTON BLVD
VANCHO RD
MAIN ST
FREMONT ST
OAKEY BLVD
WYO AVE
SAHARA AVE
FREEWAY
LAS VEGAS BLVD
PECOS RD
LAMB BLVD
NELLIS BLVD
SLOAN RD
25th ST
LAKE MEAD BLVD
OWENS AVE
BONANZA RD
CHARLESTON BLVD
SAHARA AVE
SPRING MTN RD
PARADISE RD
MARYLAND PKWY
EASTERN AVE
DESERT INN RD
POWER LINE RD.
FLAMINGO RD
MONSON RD.
NERC-LV
HARMON
TROPICANA AVE
RUSSELL RD
PATRICK LN
SUNSET RD
TOMIYASU LN.
VEGAS ESTATES
HENDERSON CUTOFF

Figure 2. NERC-LV Water Surveillance Network, Las Vegas Valley

NTS in support of AEC operations. Beginning with the January 1972 monthly water report, the analytical results of water samples collected for the above program have been reported in *Radiation Data and Reports.*

The Water Surveillance Network,[1] operated in offsite areas around the NTS, consists of 61 sampling locations (figures 1 and 2) where NERC-LV personnel collect 1-gallon water samples from wells, open and closed springs, lakes, and ponds on a monthly or quarterly basis. In the event of a release of radioactivity from the NTS, special sampling within the affected area is conducted to determine radionuclide concentrations.

Previously, the network consisted of 90 sampling locations, as described in the December 1972 issue of *Radiation Data and Reports.* A reduction of sampling locations was implemented this year to economize operations and yet provide adequate coverage in the event of a release.

Table 1. Analytical procedures

Type of analysis	Analytical equipment	Counting period (minutes)	Analytical procedures	Sample size (liter)	Detection limits (pCi/liter)
Gamma [a]	Gamma spectrometer with a 10- by 10-cm NaI(Tl) crystal with input to 200 channels (0-2 MeV) of 400- channel pulse-height analyzer.	10-40	Radionuclide concentrations quantitated from gamma spectrometer data by computer using an eight element matrix technique.	3.5	Generally 10 pCi/liter for most common fallout radionuclides in a simple spectrum
Tritium	Automatic liquid scintillation counter with output printer.	100	Sample prepared by distillation and counted in scintillation counter.	.005	[b], [c] =320
Strountium-89-, strontium-90	Low background, thin-window, gas flow proportional counter with a 5.7-cm-diameter window (80 μg/cm²).	50	Chemical separation by ion exchange. Separated sample counted successively; activity calculated by solution of simultaneous equations.	1.0	[b]Strontium-89 =5 [b]Strontium-90 =2
Radium-226	Alpha scintillation counter.	30	Chemical separation of radium. Separated sample dissolved and quantitated by radon emanation procedure.	1.5	[b] =0.1
Gross alpha,[d] gross beta [d] liter	Low background, thin-window gas flow proportional counter with a 5.7-cm diameter window (80 μg/cm²).	50	Sample evaporated, and residue counted.	.2	[d] alpha =2 [b] beta =2

[a] On total liquid sample.
[b] The detection limit for a given sample is defined as that concentration which is equal to the 2-sigma counting error.
[c] The detection limit for samples analyzed during February 1972 and thereafter was =220 pCi/liter.
[d] On total solids of samples.

Table 2. Water surveillance results, January 1973

Location	Date collected (1973)	Sample type[a]	Radioactivity concentrations[b] (pCi/liter)		
			Gross alpha	Gross beta	Tritium
California:					
Bishop:					
Fish and Game Office	1/3	23	<1.8	<3.3	NA
Death Valley Junction:					
Lila's Cafe	1/4	23	<5.6	7.0 ±3.8	<230
Furnace Creek:					
Pond	1/4	21	<4.3	7.0 ±3.7	NA
Visitor Center	1/4	27	<4.3	6.2 ±3.6	NA
Hinkley:					
Bill Nelson Dairy	1/3	23	12 ±6.5	4.3 ±3.5	NA
Lone Pine:					
Forest Service Ranger Station	1/3	23	<2.2	<3.3	NA
Olancha:					
Haiwee Reservoir	1/3	21	8.8 ±5.0	4.8 ±3.5	NA
Ridgecrest:					
City Hall	1/3	23	<4.1	<3.4	NA
Nevada:					
Adaven:					
Canfield Ranch	NS				
Alamo:					
Pahranagat Lake	1/8	21	16 ±7.5	18 ±4.2	NA
Sheri's Bar	1/8	23	<6.3	<3.6	NA
Williams Dairy	1/8	23	<4.0	11 ±3.8	NA
Ash Meadows:					
Ash Meadows Lodge	1/9	23	9.8 ±7.4	14 ±4.3	<240
Ash Meadows Pond	1/9	21	24 ±9.2	14 ±4.2	NA
Austin:					
Nevada National Bank	1/3	27	28 ±7.3	9.8 ±3.7	NA
Blue Diamond:					
Post Office	1/8	23	5.2 ±4.5	<3.5	<240
Blue Jay Highway:					
Maintenance Station	1/11	23	<3.6	<3.5	NA
Cactus Springs:					
Mobil Service Station	1/11	27	<2.4	<3.5	<240
Caliente:					
Agricultural Extension Station	1/10	23	<3.8	<3.3	NA
Clark Station:					
Five Mile Ranch	1/10	27	<2.1	5.7 ±3.6	NA
Currant:					
Currant Ranch Cafe	NS				
Diablo:					
Highway Maintenance Station	1/10	23	<3.4	7.4 ±3.6	NA
Reed Ranch	1/10	21	28 ±11	41 ±5.6	NA

See footnotes at end of table.

Table 2. Water surveillance results, January 1973—continued

Location	Date collected (1973)	Sample type[a]	Radioactivity concentrations[b] (pCi/liter)		
			Gross alpha	Gross beta	Tritium
Elgin:					
Water Tower	1/10	23	7.9±5.9	6.2±3.5	NA
Ely:					
Chevron Service Station	NS				
Comins Lake	NS				
Eureka:					
Highway Maintenance Station	1/9	24	3.5±3.5	<3.3	NA
Goldfield:					
Chevron Service Station	1/15	23	<2.6	<3.5	NA
Hiko:					
Crystal Springs	1/8	27	5.6±4.2	5.6±3.4	NA
Schofield Dairy	1/8	23	17±7.9	25±4.6	NA
Las Vegas:					
Craig Ranch Golf Course	1/15	23	8.6±4.3	<3.5	<250
Desert Game Range	1/11	23	5.7±3.6	<3.5	<240
Lab II, NERC-LV	1/15	24	<4.9	7.4±3.6	760±270
Lake Mead Vegas Wash	1/15	21	<4.7	11±4.0	640±260
L V Water District Well 28	1/15	23	<3.2	<3.3	<250
Municipal Golf Course	1/15	23	<2.4	3.4±3.3	<250
Tule Springs	1/11	23	3.3±3.0	<3.5	<240
Tule Springs Pond	1/11	21	6.8±3.8	<3.5	NA
Vegas Estates	1/15	23	<4.2	5.3±3.8	<250
Lida:					
Lida Livestock Company	1/15	27	<2.4	<3.4	NA
Pond at storage tank	1/15	21	5.3±3.7	<3.4	NA
Lund:					
Gardner Grocery	1/11	23	<3.0	<3.3	NA
Manhattan:					
Country store	1/16	23	18±7.2	4.6±3.6	NA
Mesquite:					
Hughes Bros. Dairy	1/8	23	<5.2	6.7±3.8	NA
Moapa:					
Pedersen Valley View Ranch	1/8	27	<5.1	9.9±3.8	NA
Mt. Charleston:					
Kyle Canyon Fire Station	1/11	27	<3.1	<3.5	<240
N[illegible]ala:					
Sharp's Ranch	1/16	23	<2.5	<3.4	NA
Pahrump:					
Texaco Service Station	1/8	23	<2.9	<3.5	NA
Pioche:					
County Courthouse	1/9	24	<3.0	3.4±3.3	NA
Round Mountain:					
Mobil Service Station	1/16	24	<2.1	<3.4	NA
Scotty's Junction:					
Chevron Service Station	1/15	23	<4.2	8.6±3.9	<240
Springdale:					
Pond	1/10	21	6.8±5.8	4.2±3.7	NA
Sunnyside:					
Adam McGill Reservoir	1/11	21	10±5.0	<3.5	NA
Wildlife Management Headquarters	1/11	27	<2.7	<3.5	NA
Tonopah:					
Jerry's Chevron Station	1/17	23	3.1±2.9	5.3±3.5	NA
Tonopah Test Range CP-1	1/17	23	5.5±4.2	5.8±3.6	NA
Warm Springs:					
Fallini's Pond	NS				
Service Station and Cafe	NS				
Twin Springs Ranch	1/11	23	5.6±4.7	11±4.0	NA
Utah:					
Cedar City:					
M. D. Baldwin residence	1/9	24	<1.9	<3.5	NA
St. George:					
R. Cox Dairy	1/8	24	3.5±2.4	<3.5	NA

[a] 21—Pond, lake, reservoir, stock tank, stock pond.
22—Stream, river, creek.
23—Well
24—Multiple supply mixed (a water sample consisting of mixed or multiple sources of water such as well and spring).
27—Spring.
[b] Two-sigma counting error provided when available.
NA, not analyzed.
NS, no sample.

Analytical procedures

All samples are analyzed by gamma spectroscopy and counted for gross alpha and gross beta radioactivity. In addition, samples from 14 locations west, south, and southeast of NTS are routinely analyzed for tritium. For the purpose of identifying the source of gross radioactivity in all network samples and comparing sample concentrations with both the AEC concentration guides and the PHS Drinking Water Standards, selected samples from each sampling location are given special analyses at least once each year. For surface water samples, the special analyses include strontium-89, strontium-90, plutonium-238, plutonium-239, uranium, and radium-226. For drinking water samples, the analyses include strontium-89, strontium-90, uranium, and radium-226. Additional special analyses are performed on selected samples when indicated by gross alpha or gross beta concentrations, and when radioactivity related to AEC operations is detected by gamma spectroscopy.

Table 1 lists the general analytical procedures and detection limits, as described by Johns (*1*) and Lem and Snelling (*2*). For gamma spectroscopy analysis, the samples are placed in 3.5-liter inverted-well Marinelli beakers. All routine samples are counted 40 minutes. Special samples collected following known releases of radioactivity are normally counted for 20 minutes, but this may vary from 10 to 40 minutes, depending upon radionuclide concentrations and total sample workload. The radioactivity concentration of each of the detected radionuclides at time of count is calculated and extrapolated to time of collection.

Results

The routine analytical results of all water samples collected in January 1973 by the NERC-LV water surveillance program are listed in table 2. No gamma-emitting fission products were identified by gamma spectrometry in any of the samples collected in January 1973. The analytical results for samples selected for special analyses will be reported at a later date.

REFERENCES

(*1*) JOHNS, F. B. Southwestern Radiological Health Laboratory handbook of radiochemical analytical methods, SWRHL-11. Southwestern Radiological Health Laboratory, Las Vegas, Nev. (March 1970).

(*2*) LEM, P. N. and R. N. SNELLING. Southwestern Radiological Health Laboratory data analysis and procedures manual, SWRHL-21. Southwestern Radiological Health Laboratory, Las Vegas, Nev. (March 1971).

SECTION III. AIR AND DEPOSITION

Radioactivity in Airborne Particulates and Precipitation

Continuous surveillance of radioactivity in air and precipitation provides one of the earliest indications of changes in environmental fission product radioactivity. To date, this surveillance has been confined chiefly to gross beta radioanalysis. Although such data are insufficient to assess total human radiation exposure from fallout, they can be used to determine when to modify monitoring in other phases of the environment.

Surveillance data from a number of programs are published monthly and summarized periodically to show current and long-range trends of atmospheric radioactivity in the Western Hemisphere. These include data from activities of the Environmental Protection Agency, the Canadian Department of National Health and Welfare, Pan American Health Organization and the California State Department of Public Health.

In addition to those programs presented in this issue, the following programs were previously covered in *Radiation Data and Reports.*

Network	Period	Issue
Fallout in the United States and other areas, *HASL*	January–December 1970	December 1971
Mexican air monitoring program	September–December 1972	June 1973
Plutonium in airborne particulates	October–December 1972	June 1973
Surface air sampling program, 80th Meridian Network, HASL	1970	May 1973

1. Radiation Alert Network
March 1973

Quality Assurance and Environmental
Monitoring Laboratory,
National Environmental Research Center—
Research Triangle Park,
Environmental Protection Agency

Surveillance of atmospheric radioactivity in the United States is conducted by the Radiation Alert Network (RAN) which regularly gathers samples at 68 locations distributed throughout the country (figure 1). Most of the stations are operated by State health department personnel.

The station operators perform "field estimates" on the airborne particulate samples at 5 hours after collection, when most of the radon daughter products have decayed, and at 29 hours after collection, when most of the thoron daughter products have decayed. They also perform field estimates on dried precipitation samples and report all results to appropriate Environmental Protection Agency officials by mail or telephone depending on levels found. A compilation of the daily field estimates is available upon request from the Quality Assurance and Environmental Monitoring Laboratory, NERC-RTP, EPA, Research Triangle Park, N.C. 27711. A detailed description of the sampling and analytical procedures was presented in the March 1968 issue of *Radiological Health Data and Reports*.

Table 1 presents the monthly average gross beta radioactivity in surface air particulates and deposition by precipitation, as measured by the field estimate technique, during March 1973.

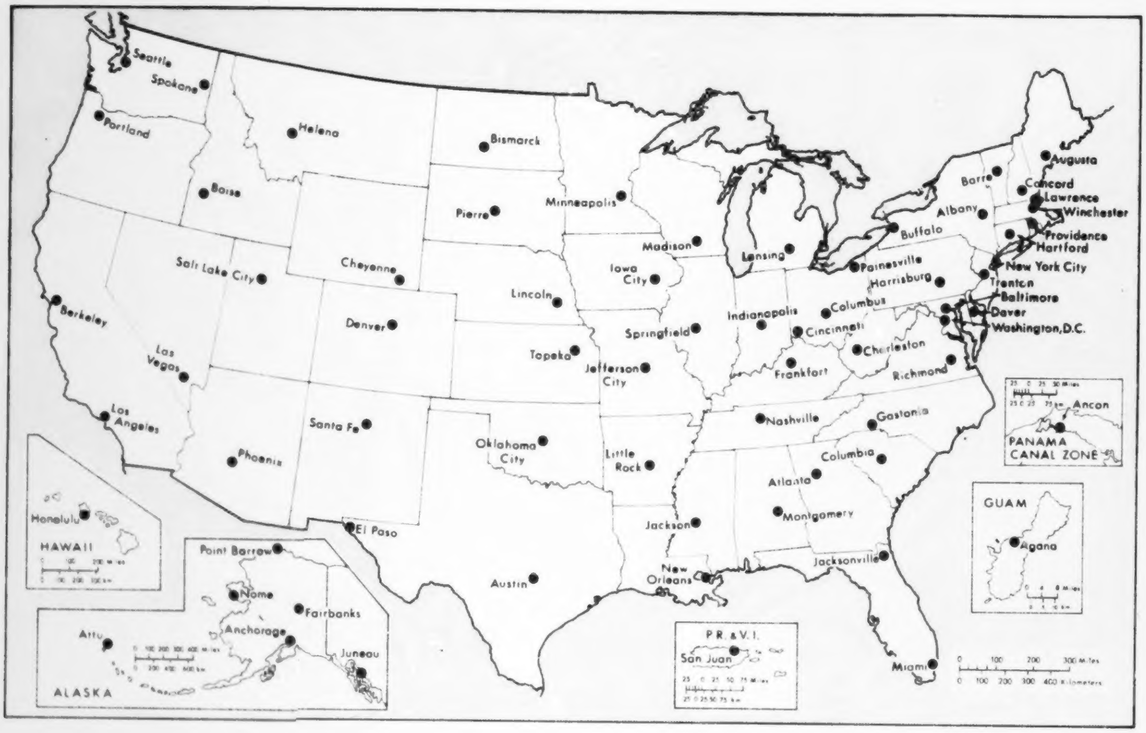
Seattle
Spokane
Portland
Helena
Bismarck
Boise
Pierre
Minneapolis
Salt Lake City
Cheyenne
Madison
Lansing
Iowa City
Lincoln
Berkeley
Denver
Springfield
Indianapolis
Columbus
Cincinnati
Topeka
Jefferson City
Frankfort
Charleston
Richmond
Las Vegas
Los Angeles
Phoenix
Santa Fe
Oklahoma City
Little Rock
Nashville
Gastonia
Columbia
Atlanta
Montgomery
Jackson
El Paso
Austin
New Orleans
Jacksonville
Miami
Augusta
Barre
Concord
Lawrence
Winchester
Albany
Buffalo
Providence
Hartford
Painesville
Harrisburg
New York City
Trenton
Baltimore
Dover
Washington, D.C.
Ancon
PANAMA CANAL ZONE
GUAM
Agana
P.R. & V.I.
San Juan
Honolulu
HAWAII
Point Barrow
Nome
Fairbanks
Attu
Anchorage
Juneau
ALASKA

Figure 1. Radiation Alert Network sampling stations

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Table 1. Gross beta radioactivity in surface air and precipitation, March 1973

Station location		Number of samples	Gross beta radioactivity (5-hour field estimate) (pCi/m³)			Number of samples	Total depth (mm)	Precipitation		
								Field estimation of deposition		
			Maximum	Minimum	Average [a]			Number of samples	Depth (mm)	Total deposition (nCi/m²)
Ala:	Montgomery	22	2	0	1	5	122	5	122	13
Alaska:	Anchorage	2	0	0	0	0				
	Attu Island	31	0	0	0	0				
	Fairbanks	0				0				
	Juneau	0				0				
	Nome	0				0				
	Point Barrow	0				0				
Ariz:	Phoenix	19	7	0	2	0				
Ark:	Little Rock	0				0				
Calif:	Berkeley	22	[illegible]	0	0	6	50	6	50	0
	Los Angeles	21	1	0	0	0				
C.Z:	Ancon	18	0	0	0	0				
Colo:	Denver	22	3	0	1	4	32	(b)		
Conn:	Hartford	22	0	0	0	7	84	7	84	0
Del:	Dover	22	0	0	0	0				
D.C:	Washington	22	1	0	0	0				
Fla:	Jacksonville	19	1	0	0	6	132	6	132	2
	Miami	8	0	0	0	3	36	3	36	0
Ga:	Atlanta	12	1	0	0	0				
Guam:	Agana	0				0				
Hawaii:	Honolulu	21	0	0	0	6	48	(b)		
Idaho:	Boise	22	2	0	1	2	21	2	21	4
Ill:	Springfield	15	1	0	0	0				
Ind:	Indianapolis	0				0				
Iowa:	Iowa City	21	3	0	1	5	89	5	89	9
Kans:	Topeka	22	2	0	1	11	175	11	175	5
Ky:	Frankfort	14	1	0	1	0				
La:	New Orleans	19	1	0	0	10	277	(b)		
Maine:	Augusta	18	0	0	0	5	35	5	35	0
Md:	Baltimore	21	2	0	0	7	58	7	58	0
Mass:	Lawrence	22	1	0	0	5	60	5	60	0
	Winchester	20	2	0	0	6	63	6	63	0
Mich:	Lansing	21	0	0	0	0				
Minn:	Minneapolis	22	1	0	0	6	48	6	48	9
Miss:	Jackson	11	0	0	0	7	177	7	177	0
Mo:	Jefferson City	22	1	0	0	0				
Mont:	Helena	17	2	0	1	0				
Nebr:	Lincoln	22	3	0	1	4	84	4	84	10
Nev:	Las Vegas	22	4	0	1	0				
N.H:	Concord	0				0				
N.J:	Trenton	21	1	0	0	7	104	7	104	2
N. Mex:	Santa Fe	18	1	0	1	6	36	6	36	0
N.Y:	Albany	18	1	0	1	0				
	Buffalo	22	1	0	0	0				
	New York City	0				0				
N.C:	Gastonia	22	6	0	1	6	48			
N. Dak:	Bismarck	22	4	0	1	4	14	4	14	3
Ohio:	Cincinnati	0				0				
	Columbus	2	0	0	0	0				
	Painesville	21	0	0	0	7	75	7	75	11
Okla:	Oklahoma City	0				0				
Oreg:	Portland	22	0	0	0	10	71	10	71	3
Pa:	Harrisburg	19	1	0	0	0				
P.R:	San Juan	0				0				
R.I:	Providence	20	1	0	0	0				
S.C:	Columbia	10	1	0	0	7	162	7	162	0
S. Dak:	Pierre	17	4	1	2	0				
Tenn:	Nashville	22	1	0	0	12	222	12	222	0
Tex:	Austin	20	5	1	2	2	25	(b)		
	El Paso	16	5	1	1	0				
Utah:	Salt Lake City	31	2	0	0	9	47	9	47	3
Vt:	Barre	20	1	0	0	6	53	6	53	8
Va:	Richmond	16	0	0	0	6	60	6	60	3
Wash:	Seattle	9	0	0	0	7	63	(b)		
	Spokane	19	2	0	1	0				
W. Va:	Charleston	22	2	0	1	11	82	11	82	7
Wisc:	Madison	22	1	0	0	6	122	6	122	3
Wyo:	Cheyenne	8	2	0	1	0				
Network summary		1,053	7	0	1	211	103	7	85	3

[a] The monthly average is calculated by weighting the field estimates of individual air samples with length of sampling period.
[b] This station is part of the tritium surveillance system. No gross beta measurements are done.

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2. Canadian Air and Precipitation Monitoring Program,[1] March 1973

Radiation Protection Division
Department of National Health and Welfare

The Radiation Protection Division of the Canadian Department of National Health and Welfare monitors surface air and precipitation in connection with its Radioactive Fallout Study Program. Twenty-four collection stations are located at airports (figure 2), where the sampling equipment is operated by personnel from the Meteorological Services Branch of the Department of Transport. Detailed discussions of the sampling procedures, methods of analysis, and interpretation of results of the radioactive fallout program are contained in reports of the Department of National Health and Welfare (*1–5*).

A summary of the sampling procedures and methods of analysis was presented in the May 1969 issue of *Radiological Health Data and Reports*.

Surface air and precipitation data for March 1973 are presented in table 2.

Table 2. Canadian gross beta radioactivity in surface air and precipitation, March 1973

Station	Number of samples	Air surveillance gross beta radioactivity (pCi/m³)			Precipitation measurements	
		Maximum	Minimum	Average	Average concentration (pCi/liter)	Total deposition (nCi/m²)
Calgary	4	0.02	<0.01	0.01	8	0.1
Coral Harbour	4	.03	.01	.03	13	.2
Edmonton	4	.03	.02	.02	28	.3
Ft. Churchill	4	.03	.02	.03	25	.2
Fredericton	4	.02	.01	.02	7	.6
Goose Bay	4	.02	.01	.02	5	.2
Halifax	4	.03	.01	.02	6	.8
Inuvik	4	.04	.03	.03	38	.4
Montreal	4	.02	.01	.01	7	.6
Moosonee	4	.04	.02	.03	13	.2
Ottawa	4	.02	.01	.02	9	1.0
Quebec	4	.02	.01	.02	11	1.1
Regina	4	.02	.02	.02	39	.5
Resolute	4	.05	.03	.04	77	.1
St. John's, Nfld	1	.01	.01	.01	3	.2
Saskatoon	4	.02	.02	.02	79	.3
Sault Ste. Marie	4	.03	.02	.02	NS	NS
Thunder Bay	4	.02	.01	.02	11	.7
Toronto	3	.01	.01	.01	6	.9
Vancover	4	.01	.01	.01	12	.8
Whitehorse	4	.03	<.01	.02	20	.1
Windsor	4	.02	.01	.01	8	1.0
Winnipeg	4	.02	.02	.02	18	.2
Yellowknife	4	.03	.01	.02	7	.2
Network summary	92	0.05	<0.01	0.02	20	0.5

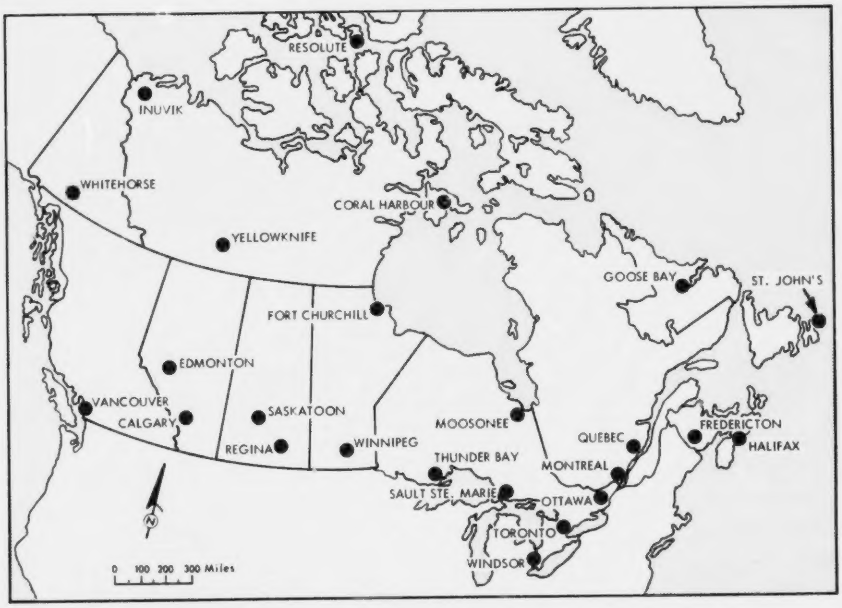
RESOLUTE
INUVIK
WHITEHORSE
CORAL HARBOUR
YELLOWKNIFE
GOOSE BAY
ST. JOHN'S
FORT CHURCHILL
EDMONTON
VANCOUVER
CALGARY
SASKATOON
REGINA
WINNIPEG
MOOSONEE
QUEBEC
FREDERICTON
HALIFAX
THUNDER BAY
MONTREAL
SAULT STE. MARIE
OTTAWA
TORONTO
WINDSOR
N
0 100 200 300 Miles

Figure 2. Canadian air and precipitation monitoring program

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[1] Prepared from information and data obtained from the Canadian Department of National Health and Welfare, Ottawa, Canada.

3. Pan American Air Sampling Program
March 1973

Pan American Health Organization and
U.S. Environmental Protection Agency

Gross beta radioactivity in air is monitored by countries in the Americas under the auspices of the collaborative program developed by the Pan American Health Organization (PAHO) and the Environmental Protection Agency (EPA) to assist PAHO-member countries in developing radiological health programs.

The air sampling station locations are shown in figure 3. Analytical techniques were described in the March 1968 issue of *Radiological Health Data and Reports*. The March 1973 air monitoring results from the participating countries are given in table 3.

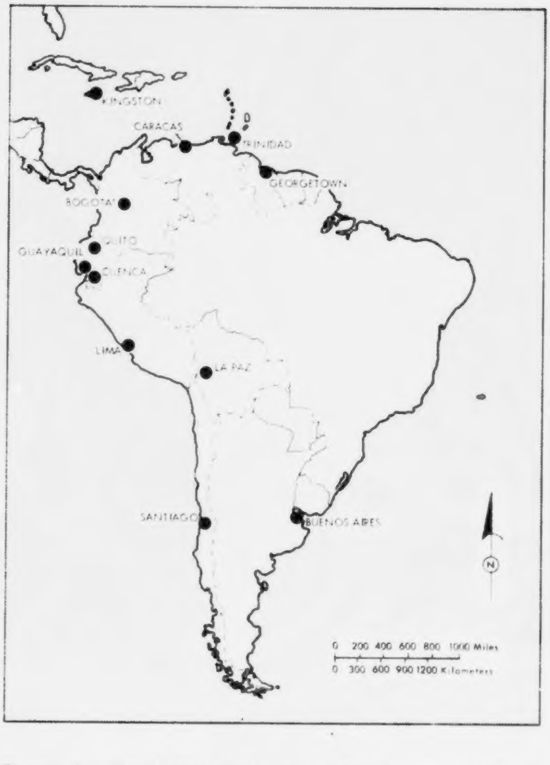

Figure 3. Pan American Air Sampling Program stations

Table 3. Summary of gross beta radioactivity in Pan American surface air, March 1973

Station location		Number of samples	Gross beta radioactivity (pCi/m³)		
			Maximum	Minimum	Average[a]
Argentina:	Buenos Aires	0			
Bolivia:	La Paz	18	0.01	0.00	0.00
Chile:	Santiago	29	.03	.01	.02
Colombia:	Bogota	21	.02	.00	.01
Ecuador:	Cuenca	8	.02	.00	.00
	Guayaquil	18	.02	.00	.01
	Quito	13	.01	.00	.00
Guyana:	Georgetown	10	.01	.00	.00
Jamaica:	Kingston	0			
Peru:	Lima	0			
Venezuela:	Caracas	11	.02	.00	.01
West Indies:	Trinidad	16	.04	.00	.02
Pan American summary		144	0.04	0.00	0.01

[a] The monthly average is calculated by weighting the individual samples with length of sampling period. Values less than 0.005 pCi/m³ are reported and used in averaging as 0.00 pCi/m³.

4. California Air Sampling Program
March 1973

Bureau of Radiological Health
California State Department of Public Health

The Bureau of Radiological Health of the California State Department of Public Health with the assistance of several cooperating agencies and organizations operates a surveillance system for determining radioactivity in airborne particulates. The air sampling locations are shown in figure 4.

All air samples are sent to the Sanitation and Radiation Laboratory of the State Department of Public Health where they are analyzed for their radioactive content.

Airborne particles are collected by a continuous sampling of air filtered through a 47 milli-

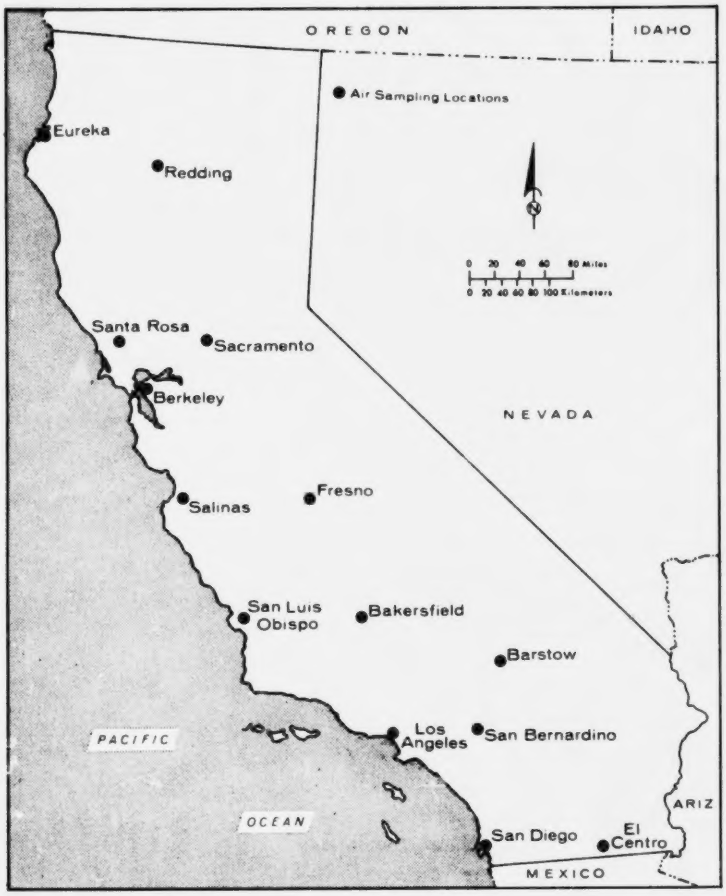
OREGON
IDAHO
Air Sampling Locations
Eureka
Redding
0 20 40 60 80 Miles
0 20 40 60 80 100 Kilometers
Santa Rosa
Sacramento
Berkeley
NEVADA
Salinas
Fresno
San Luis Obispo
Bakersfield
Barstow
PACIFIC
Los Angeles
San Bernardino
ARIZ
OCEAN
San Diego
El Centro
MEXICO

Figure 4. California air sampling program stations

meter membrane filter, 0.8 micron pore size, using a Gast air pump of about 2 cubic feet per minute capacity, or 81.5 cubic meters per day. Air volumes are measured with a direct reading gas meter. Filters are replaced every 24 hours except on holidays and weekends. The filters are analyzed for gross alpha and beta radioactivity 72 hours after the end of the collection period. The daily samples are then composited into a monthly sample for gamma spectroscopy and an analysis for strontium-89 and strontium-90. Table 4 presents the monthly gross beta radioactivity in air for March 1973. The monthly sample results are presented quarterly.

Table 4. Gross beta radioactivity in California air March 1973

Station location	Number of samples	Gross beta radioactivity (pCi/m^3)		
		Maximum	Minimum	Average
Bakersfield	29	0.33	0.00	0.10
Barstow	31	.28	.00	.10
Berkeley	29	.11	.00	.03
El Centro	28	.22	.00	.06
Eureka	30	.14	.00	.04
Fresno	30	.29	.01	.05
Los Angeles	30	.17	.00	.05
Redding	30	.18	.00	.04
Sacramento	30	.09	.00	.04
Salinas	28	.38	.00	.11
San Bernardino	27	.20	.00	.05
San Diego	26	.09	.00	.04
San Luis Obispo	30	.18	.00	.05
Santa Rosa	31	.15	.00	.03
Summary	409	0.38	0.00	0.06

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(*1*) BIRD, P. M., A. H. BOOTH, and P. G. MAR. Annual report of 1959 on the Radioactive Fallout Study Program, CNHW-RP-3. Department of National Health and Welfare, Ottawa, Canada (May 1960).

(*2*) BIRD, P. M., A. H. BOOTH, and P. G. MAR. Annual report for 1960 on the Radioactive Fallout Study Program, CNHW-RP-4. Department of National Health and Welfare, Ottawa, Canada (December 1961).

(*3*) MAR. P. G. Annual report for 1961 on the Radioactive Fallout Study Program, CNHW-RP-5. Department of National Health and Welfare, Ottawa, Canada (December 1962).

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Air Surveillance Network, March 1973

National Environmental Research Center—Las Vegas,[1] *Environmental Protection Agency*

The Air Surveillance Network (ASN), operated by the National Environmental Research Center-Las Vegas (NERC-LV), consists of 49 active and 73 standby sampling stations located in 21 western States (figures 1 and 2). The network is operated in support of nuclear testing sponsored by the Atomic Energy Commission (AEC) at the Nevada Test Site (NTS), by the Space Nuclear Systems Office at the Nuclear Rocket Development Station (which lies within the NTS), and by the AEC at any other designated testing sites.[2]

The stations are operated by State health department personnel and by private individuals on a contract basis. All active stations are operated continuously with filters being exchanged over periods generally ranging from 24 to 72 hours. All samples are mailed to the NERC-LV unless special retrieval is arranged at selected locations in response to known releases of radioactivity from the NTS. A complete description of sampling and analytical procedures was presented in the February 1972 issue of *Radiation Data and Reports.*

Results

Table 1 presents the monthly average gross beta concentrations in air for each of the network stations. The highest gross beta concentration within the network was less than 0.2 pCi/m^3 at Death Valley Junction, Calif.; Beatty,

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[1] Formerly the Western Environmental Research Laboratory.

[2] The ASN is operated under a Memorandum of Understanding (No. AT(26-1)-539) with the Nevada Operations Office, U.S. Atomic Energy Commission.

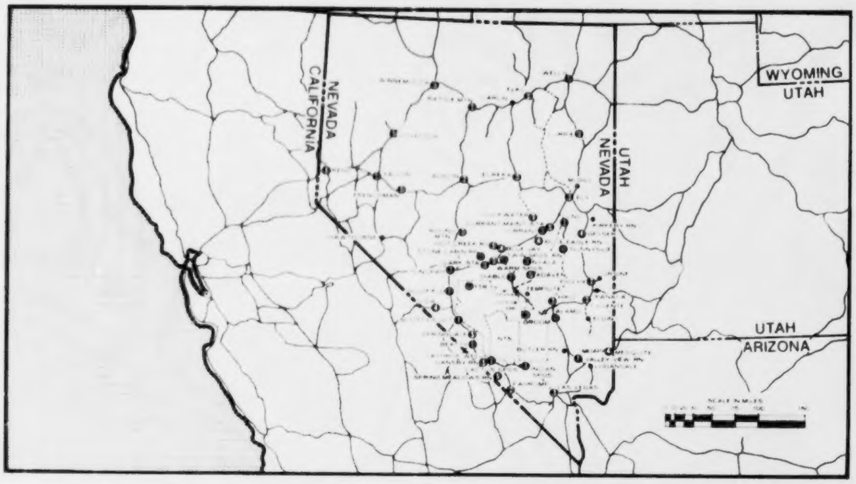

Figure 1. NERC-LV Air Surveillance Network stations in Nevada

Table 1. Summary of gross beta radioactivity concentrations in air, March 1973

Location		Number of samples	Concentration (pCi/m³)		
			Maximum	Minimum	Average [a]
Ariz:	Kingman	31	<0.1	<0.1	<0.1
	Seligman	31	<.1	<.1	<.1
Calif:	Baker	27	.1	<.1	.1
	Barstow	31	<.1	<.1	<.1
	Bishop	31	<.1	<.1	<.1
	Death Valley Junction	29	<.2	<.1	<.1
	Furnace Creek	31	<.1	<.1	<.1
	Lone Pine	24	<.1	<.1	<.1
	Needles	22	<.1	<.1	<.1
	Ridgecrest	31	<.1	<.1	<.1
	Shoshone	31	.1	<.1	<.1
Nev:	Alamo	31	.1	<.1	<.1
	Austin	23	.1	<.1	<.1
	Beatty	31	<.2	<.1	<.1
	Blue Eagle Ranch (Currant)	29	<.2	<.1	<.1
	Blue Jay	31	.1	<.1	<.1
	Caliente	30	<.1	<.1	<.1
	Currant Ranch	31	<.1	<.1	<.1
	Diablo	31	<.1	<.1	<.1
	Duckwater	28	<.1	<.1	<.1
	Ely	31	<.1	<.1	<.1
	Eureka	31	<.1	<.1	<.1
	Fallini's Twin Springs Ranch	31	<.1	<.1	<.1
	Geyser Maintenance Station	31	<.1	<.1	<.1
	Goldfield	31	<.2	<.1	<.1
	Groom Lake	21	.1	<.1	<.1
	Hiko	31	<.1	<.1	<.1
	Indian Springs	31	<.1	<.1	<.1
	Las Vegas	22	.1	<.1	<.1
	Lathrop Wells	30	<.1	<.1	<.1
	Lida	31	<.1	<.1	<.1
	Lund	31	<.1	<.1	<.1
	Mesquite	31	<.1	<.1	<.1
	Nyala	31	<.1	<.1	<.1
	Pahrump	31	<.1	<.1	<.1
	Pioche	30	<.1	<.1	<.1
	Round Mountain	31	<.1	<.1	<.1
	Scotty's Junction	30	.1	<.1	<.1
	Stone Cabin Ranch	30	<.1	<.1	<.1
	Sunnyside	30	<.2	<.1	<.1
	Tonopah	31	<.1	<.1	<.1
	Tonopah Test Range	24	<.1	<.1	<.1
	Warm Springs	29	<.1	<.1	<.1
	Warm Springs Ranch	31	<.1	<.1	<.1
Utah:	Cedar City	26	<.1	<.1	<.1
	Delta	31	<.2	<.1	<.1
	Garrison	31	<.1	<.1	<.1
	Milford	31	<.1	<.1	<.1
	St. George	31	<.1	<.1	<.1

[a] Individual values less than the minimum detectable concentration (MDC) are set equal to the MDC for averaging. A monthly average less than the minimum reportable value of 0.1 pCi/m³ is reported a <0.1.

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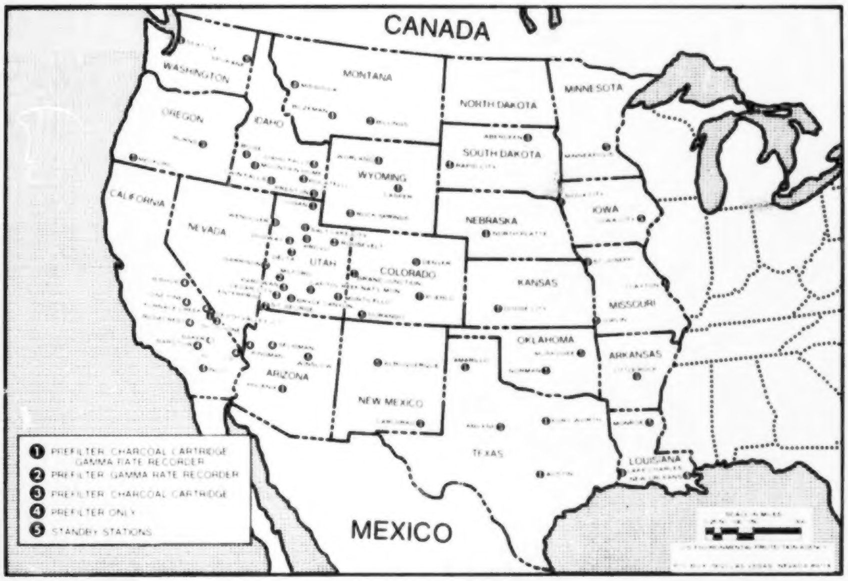
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❷ PREFILTER GAMMA RATE RECORDER
❸ PREFILTER CHARCOAL CARTRIDGE
❹ PREFILTER ONLY
❺ STANDBY STATIONS

Figure 2. NERC-LV Air Surveillance Network stations outside Nevada

Goldfield, Blue Eagle Ranch, and Sunnyside, Nev.; and Delta, Utah. The minimum reporting concentration for gross beta is 0.1 pCi/m^3. For averaging purposes, individual concentrations which are below the minimum detectable concentration (0.06 pCi/m^3) are assumed to be equal to the minimum detectable concentration. Averages less than the minimum reporting level (0.1 pCi/m^3) are reported as <0.1 pCi/m^3. No radionuclides were identified by gamma spectrometry on any filters or charcoal cartridges during March.

Complete copies of this summary and listings of the daily gross beta and gamma spectrometry results are distributed to EPA regional offices and appropriate State agencies. Additional copies of the daily results may be obtained from the NERC-LV upon written request.

SECTION IV. OTHER DATA

This section presents results from routine sampling of biological materials and other media not reported in the previous sections. Included here are such data as those obtained from human bone sampling, Alaskan surveillance, and environmental monitoring around nuclear facilities.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission (AEC) receives from its contractors annual reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant environmental surveys are required.

Releases of radioactive materials from AEC installations are governed by radiation standards set forth by AEC's Division of Operational Safety in directives published in the "AEC Manual." [1]

A summary of the environmental radioactivity data follows for the Paducah Plant.

---

[1] Title 10, Code to Federal Regulations, Part 20, "Standards for Protection Against Radiation" contains essentially the standards published in Chapter 0524 of the AEC Manual.

1. Paducah Plant [2]

January-December 1971

Union Carbide Corporation
Paducah, Ky.

The Paducah Gaseous Diffusion Plant (PGDP) is located in McCracken County, Kentucky, about 4 miles south of the Ohio River and 20 miles east of the confluence of the Ohio and Mississippi Rivers. The plant is an AEC-owned, contractor-operated uranium enrichment cascade with associated uranium hexafluoride (UF$_6$) manufacturing plant and extensive support facilities. The Paducah processing facility now consists of 1,812 diffusion stages housed in five buildings with a total ground coverage of about 74 acres. Including support facilities, the plant has a total complement of about 30 permanent buildings.

Except for the large raw water treatment plant, all buildings are within a 750-acre fenced area. A buffer area of at least 1,500 feet in depth exists on all sides of the fenced area. Beyond the AEC-owned buffer is an extensive wildlife management area deeded to the Commonwealth of Kentucky. There are no habitations within 3,000 feet of any of the process buildings. The nearest incorporated towns are Metropolis, Ill., located 5 miles to the northeast and LaCenter, Ky., located 11 miles west southwest. Paducah, Ky., a city of 35,000, is located 12 miles east of the plant.

The primary plant, the diffusion cascade, contains a physical process in which UF$_6$ is fed into the system, pumped through the diffusion stages and eventually is removed, still as UF$_6$. The product is enriched in the fissionable uranium-235 isotope and the "tails" are withdrawn at the bottom as depleted UF$_6$. The process pumps require electric power, lubrication, and air for cooling. The compressed gases are cooled by a heat exchange fluid, which is in turn cooled by recirculating cooling water.

The basic inputs to the feed manufacturing plant are hydrogen, anhydrous hydrogen fluoride (HF), and uranium oxide (UO_3). The product is uranium hexafluoride (UF_6). Theoretically, 1,000 tons of HF are required to convert 2,000 tons of uranium from the oxide to UF_6.

---

[2] Summarized from "Environmental Monitoring at Major U.S. Atomic Energy Commission Sites, Paducah Plant, Calendar Year 1971."

Some of the depleted UF_6 from the cascade is reacted with hydrogen to recover HF and to convert the volatile UF_6 to the more easily stored UF_4. In the same facility, the Metals Plant, some of the UF_4 is reduced to metal by reaction with magnesium. The reaction results in the largest volume solid waste product of the plant processes, a magnesium fluoride slag.

Air monitoring

Continuously operating air sampling stations are established on electric power poles at four locations on the perimeter fence and at five locations approximately 1 mile from the plant site. Each sampling station consists of a metal housing sheltering a 2-inch membrane filter holder and containing (as the air flows) a flow meter, a gas scrubber, flow throttling valve, and an air pump. Air flow through the system is adjusted to 0.3 cfm (86 cubic meters per week). The membrane filter is removed each week for long-lived alpha and beta radioactivity determinations.

The gas bubbler is filled to about a 6-inch depth with glass beads to disperse the air in the scrubbing solution of about 1 liter of 0.025 normal sodium hydroxide. This collection technique is essentially 100 percent efficient for HF collection in the parts per billion range. The fluoride content is determined by the specific ion electrode method. Results of the environmental air sampling program are shown in table 1.

Alpha radioactivity attributed to uranium from the plant averaged less than the minimum detectable level at the outer edge of the buffer zone. The samplers on the north and east perimeter fences, which are nearest the Feed Plant and the Metals Plant, collected detectable amounts. Beta radioactivity levels at all stations and in all samples were far below the applicable concentration guide.

All gas scrubber samples collected offsite over weeklong periods and analyzed for fluorides were within the Kentucky ambient air standard. The average results were about 20 percent of the standard.

Water monitoring

Water samples are collected continuously in the Big Bayou and in the Little Bayou (essentially a drainage ditch traversing AEC and TVA property). Grab samples are taken each month from several locations in the Ohio River, at the mouth of the Bayous, and from two test wells. The effluent from the sewage disposal plant is sampled for weekly determinations of suspended solids and BOD.[2] Weekly grab samples for BOD determination also are taken upstream and downstream from the sewage plant outfall.

---

[2] BOD, biological oxygen demand.

Table 1. Environmental air sampling results, Paducah Plant, January-December 1971

Sampling point [a]	Number of samples	Alpha radioactivity concentration (fCi/m^3)			Beta radioactivity concentration (pCi/m^3)		
		Maximum	Minimum	Average	Maximum	Minimum	Average
At plant perimeter fence:							
North	52	150	20	30	17	<0.1	<2.8
East	52	470	20	40	4.2	<.1	<.7
South	52	50	<20	<20	2.9	<.1	<.4
West	52	70	<20	<20	2.0	<.1	<.5
1 mile outside plant perimeter fence:							
North	52	80	<20	<20	1.0	<.1	<.4
East	52	90	<20	<20	.7	<.1	<.3
Southeast	52	40	<20	<20	.9	<.1	<.3
South	52	80	<20	<20	.7	<.1	<.2
West	52	80	<20	<20	.8	<.1	<.3

[a] See figure 1.

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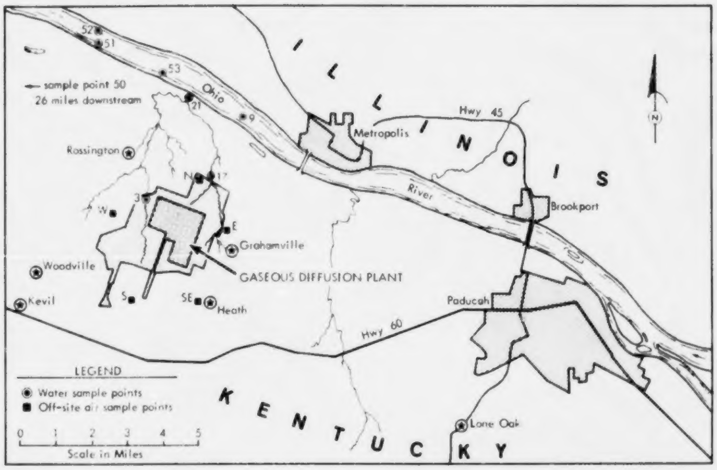
52
51
53
Ohio
21
9
sample point 50
26 miles downstream
ILLINOIS
Hwy 45
Metropolis
River
Brookport
Rossington
N
17
3
W
E
Grahamville
GASEOUS DIFFUSION PLANT
Woodville
Kevil
S
SE
Heath
Paducah
Hwy 60
LEGEND
Water sample points
Off-site air sample points
0 1 2 3 4 5
Scale in Miles
KENTUCKY
Lone Oak
N

Figure 1. Sampling locations, Paducah Gaseous Diffusion Plant

The extensive water sampling and analyses showed no increase in concentrations of the parameters of interest in either the Ohio River or in ground water (table 2). The concentration of hexavalent chromium at the mouth of the combined creeks was slightly in excess of the Ohio River Valley Water Sanitation Commission (ORSANCO) 70–1 discharge standard of 0.05 mg/liter. The concentrations of uranium and beta radioactivity in the Big Bayou and at the mouth of the creek were well within the ORSANCO and AEC limits. The results of

Table 2. Uranium and beta emitter concentrations in environmental water samples, Paducah Plant, January-December 1971

Sampling point[a]	Number of samples	Uranium (mg/liter)					Beta (pCi/liter)				
		Maximum	Minimum	Average	Standard	Percent of standard	Maximum	Minimum	Average	Standard	Percent of standard
Ohio River:											
9	12	0.009	0.001	0.004	[b] 0.009	44	54	0.0	10	[b] 1,000	1
50, 51, 52, and 53[c]	12	.015	.001	.004	[b] .009	44	72	.0	10	[b] 1,000	1
Big Bayou[d]											
1	12	.011	.001	.003	NA		250	.0	43	NA	
3	52	.170	.001	.022	NA				34	NA	
Mouth of creek:											
21	12	.029	.001	.008	60	.01	610	.0	92	[e] 20,000	.5
Little Bayou[f]											
17	52	11.5	.017	.58	NA		8,600	225	1,700	NA	
Ground water:											
11	12	.006	.001	.002	NA		350	.0	36	NA	
12	12	.006	.001	.002	NA		170	.0	25	NA	

[a] See figure 1.
[b] Kentucky Water Pollution Control Commission regulation WP-4-1.
[c] 50–53, composites.
[d] Unclassified.
[e] Ohio River Valley Sanitation Commission Pollution Control Standard 70–1 (standard for thorium-234).
[f] Unclassified stream on government property.
NA, no analysis.

analyses of the effluent from the sewage disposal plant reflect favorable operating conditions of the secondary treatment.

Soil, flora, and fauna

A set of soil samples was collected from near each of the air sampling stations. Plugs of soil 3½ inches in diameter were removed from the ground down to a uniform depth of 4 inches, dried, pulverized, and blended before analysis. Duplicate aliquots were spiked with uranium-233 and the uranium was quantitatively removed and analyzed by mass spectrometry. The results (table 3) ranged from 0.9 ppm to 2.2 ppm at one of the 1-mile stations and from 3.6 to 24.0 ppm at the perimeter fence. None of these concentrations would be expected to have a significant impact on the environment.

Table 3. Perimeter and offsite concentrations of uranium in soil, Paducah Plant, January-December 1971

Sampling point[a]	Concentation (μg/g dry weight)	Location	Concentration (μg/g dry weight)
At plant perimeter fence:		Offsite:	
North	11.0	North	2.2
East	24.0	East	1.6
South	3.6	South	.9
West	3.9	Southeast	1.1
		West	1.4
Background sample taken 12 miles from plant	.9		

[a] See figure 1.

Grass samples were taken at each of the 1-mile and 5-mile collection stations and were analyzed for fluorides (table 4). The results of the analyses at these stations were all less than 51 percent of the Kentucky fluoride-in-grass standard.

Leaves and grass in the vicinity of the Paducah Plant were examined for possible fumigation damage. None typical of fluorides was observed except for occasional marginal and trip necrosis of broad leaf grass on AEC property.

The area around the plant is in the west Kentucky wildlife management area and supports thriving populations of deer, rabbit, quail, and other wildlife. According to wildlife area management, game taken and checked through the control station appears to have been healthy and no abnormalities were found in a number of rabbits submitted to a State laboratory for examination.

Summary

Air, water, soil, and grass in the vicinity of the Paducah Gaseous Diffusion Plant were continuously or periodically sampled during 1971 at the locations shown on figure 1. Analyses for materials known to be in plant effluents were made to provide effluent control information and to determine compliance with applicable air and water quality standards.

Table 4. Fluoride-in-grass determinations, Paducah Plant, January-December 1971

Sampling point[a]	Number of samples	μg F per gram of dry grass				
		Maximum	Minimum	Average	Standard[b]	Percent of standard
At plant perimeter fence:						
North	6	329	24	150	NA	
East	6	84	17	71	NA	
South	6	43	5.8	24	NA	
West	6	38	4.2	27	NA	
1 mile outside plant perimeter fence:						
North	6	74	.4	20	40	50
Northeast	6	14	5	9.1	40	23
East	6	14	.4	9.2	40	23
East Southeast	6	20	5.0	13	40	32
Southeast	6	15	4.8	11	40	27
South	6	16	4.0	11	40	27
West	6	11	3.2	6.7	40	17
Northwest	6	25	4.2	14	40	35
5 miles outside perimeter fence:						
Northeast	6	12	4.4	8.2	40	20
Southeast	6	12	1.8	5.7	40	14
Southwest	6	11	6.4	9.6	40	24
Northwest	6	15	3.2	9.1	40	23

[a] See figure 1.

[b] Kentucky APCC regulation requires average concentration of F in or on forage not to exceed 40 ppm (μg/g) over growing season (Kentucky APCC-9). Not applicable to onsite perimeter sample point locations.

The air analyses for radioactivity indicate concentrations at all offsite sampling stations averaged less than 1 percent of the applicable AEC standards.[1] Air and grass offsite analyses for fluorides met the Kentucky air quality requirements (*1*).

A set of soil samples collected to provide historical background data was analyzed for uranium. The results ranged from 0.9 ppm to 2.2 ppm at one of the 1-mile stations and from 3.6 ppm to 24.0 ppm at the perimeter fence monitoring stations. None of these concentrations would be expected to have a significant impact on the environment.

There was no detectable change in chemical, physical, or radioactive characteristics of either the Ohio River or ground water attributable to Paducah Gaseous Diffusion Plant operations. The results of water sample analyses of the Ohio River show the chromium and fluoride concentrations were in compliance with the requirements of the applicable Kentucky regulations (*2*). The concentration of hexavalent chromium at the mouth of the combined Big and Little Bayous is slightly in excess of the ORSANCO (*3*) discharge standard of 0.05 ppm. Engineering studies are in progress on chromium removal facilities.

REFERENCES

(*1*) KENTUCKY AIR POLLUTION CONTROL COMMISSION. Kentucky Air Pollution Control Commission Regulation, APCC-9, Ambient air quality, standards.

(*2*) KENTUCKY WATER POLLUTION CONTROL COMMISSION. Kentucky Water Pollution Control Commission regulation WP-4-1.

(*3*) OHIO RIVER VALLEY WATER SANITATION COMMISSION. Ohio River Valley Water Sanitation Commission (ORSANCO), Pollution control standard No. 70-1.

Recent coverage in *Radiation Data and Reports:*

Period	Issue
July–December 1970	April 1972

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Reported Nuclear Detonations, June 1973

(Includes seismic signals presumably from foreign nuclear detonations)

The U.S. Atomic Energy Commission conducted underground nuclear tests at its Nevada Test Site on June 5 and 6, 1973. The June 5th test was in the low yield range of less than 20 kilotons TNT equivalent and the June 6th test was in the intermediate yield range (200 kilotons to 1 megaton TNT equivalent).

The Peoples Republic of China set off a nuclear explosion in the atmosphere just before midnight, June 26, 1973, at their Lop Nor nuclear test area in northwest China. The yield was in the range of 2 to 3 megatons.

On June 28, 1973, the Atomic Energy Commission announced that it had conducted an underground nuclear test in the low-intermediate yield range (20 to 200 kilotons TNT equivalent) at its Nevada Test Site.

Not all of the nuclear detonations in the United States are announced immediately, therefore, the information in this section may not be complete. A complete list of announced U.S. nuclear detonations may be obtained upon request from the Division of Public Information, U.S. Atomic Energy Commission, Washington, D.C. 20545.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1973 514-850/12

RADIATION DATA AND REPORTS

Volume 14, Number 8, August 1973

Radiation Data and Reports, a monthly publication of the Environmental Protection Agency, presents data and reports provided by Federal, State, and foreign governmental agencies, and other cooperating organizations. Pertinent original data and interpretive manuscripts are invited from investigators.

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. This responsibility was delegated to the Bureau of Radiological Health, Public Health Service. Pursuant to the Reorganization Plan No. 3 of 1970, effective December 2, 1970, this responsibility was transferred to the Radiation Office of the Environmental Protection Agency which was established by this reorganization.

The Federal agencies listed below appoint their representatives to a Board of Editorial Advisors. Members of the Board advise on general publications policy; secure appropriate data and manuscripts from their agencies; and review those contents which relate to the special functions of their agencies.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
John R. Quarles, Jr., Acting Administrator

Reports

The Potential Eye Exposure to Personnel Using Fluoroscopic Techniques[1]

H. D. Maillie, Ph.D.,[2] *and W. D. Gregory, M.S.*[3]

Measurements were made on a mockup to estimate the weekly exposure to the eyes of personnel working in the vicinity of a fluoroscope used in diagnostic radiology. A radiologist utilizing the image intensifier and protected by means of a lead drape and panel could receive 36 mR/week to the eyes, whereas other individuals positioned away from this area, but in the vicinity of the table, could receive up to 700 mR/week. The factors associated with these estimates, and the importance of wearing personnel monitors where they will estimate eye exposures are discussed.

Some confusion exists among personnel using fluoroscopic techniques as to the evaluation of the hazards associated with the use of such x-ray equipment. Many suggestions have been made as to where individuals should wear personnel monitoring devices. These have been summarized by Bushong (*1*) who concluded that if only one such device is supplied, it should be worn on the collar above the lead apron. The reason given was that this area received the highest percent of the appropriate maximum permissible dose equivalent (MPD).

An additional reason may be presented for agreement with this conclusion: this position, on the collar above the lead apron, represents the most convenient location for estimating the dose to the eyes. The dose to the lens of the eye legally fits into the definition of dose to the whole body (*2–4*).

Recent studies (*5,6*) have indicated that for a cardiac catheterization procedure, the eyes of an experienced cardiologist received an average exposure of 18 mR and the eyes of a senior resident, 30 mR. It is easily shown that even an experienced cardiologist working under the conditions specified, and not utilizing any eye protection, could perform only five catherizations per week and remain within the MPD for the lens of the eye.

There is evidence that similar types of eye exposures may exist with other fluoroscopic equipment (*7*), and with other methods.

Purpose of study

Scattered radiation measurements were made in the vicinity of a fluoroscope used in abdominal studies in diagnostic radiology. Such exposure rates were determined at eye level, and at positions known to be occupied by personnel during many fluoroscopic techniques. Knowing these exposure rates, and the estimated work load of the unit, estimates were made of the dose equivalent to the eyes of the people who occupy those locations.

Methods

A presswood phantom with a cross-section of 12 by 12 inches and a thickness of 7¾ inches was placed in the beam on the fluoroscopy table. The image intensifier was lowered to a point above the phantom which would approximate its location when a patient study was performed. The beam size was set at its largest value under these conditions (i.e., the largest area which would not exceed the area of the image intensifier screen). The unit was operated at 120 kVp and 1.0 mA. The unit was operated under conditions similar to those used during a fluoroscopic procedure, in particular, a lead drape covering the area between the image intensifier and the table top was in place and a lead panel was lifted into place along the length of the table. It was felt that this set of conditions tended to maximize the scattered radiation which was likely to be seen in the normal use of this unit.

---

[1] This paper is based on work performed under contract with the U.S. Atomic Energy Commission at the University of Rochester Atomic Energy Project and has been assigned Report No. UR-3490-318.

[2] Dr. Maillie is associate professor of the Department of Radiation Biology and Biophysics, and director, Health Physics Division, University of Rochester School of Medicine and Dentistry, Rochester, N.Y. 14642.

[3] Mr. Gregory is health physicist of the Health Physics Division, University of Rochester School of Medicine and Dentistry, Rochester, N.Y. 14642.

Figure 1 shows the floor plan of this unit, and the locations (A–E) which are known to be occupied by personnel working in this room during fluoroscopic techniques. Scattered radiation measurements were made at these positions. Such measurements were made at a height of 5 feet above floor level in an effort to approximate eye level.

The work loads and other factors were estimated by the technologist in charge of the room, and were stated to be:

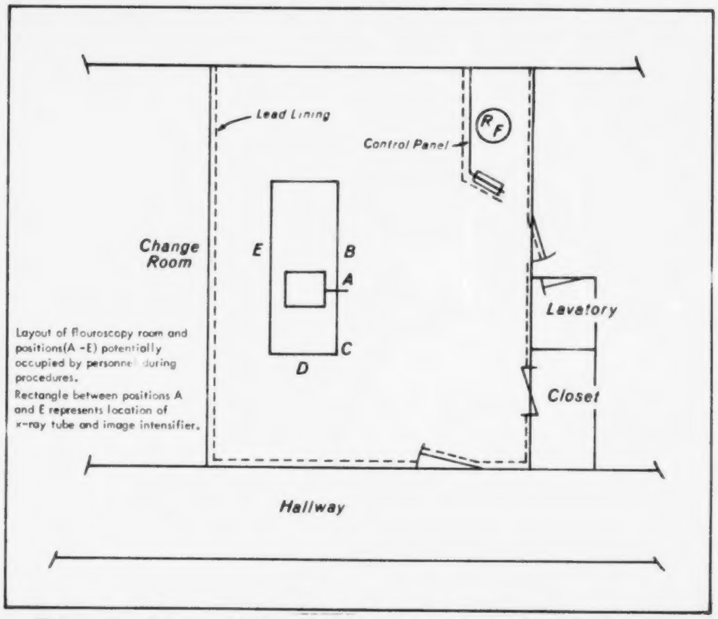
1. straight fluoroscopy (95 to 110 kVp at 2 mA)—660 mA-min/week,
2. 70 mm (100 to 120 kVp at 200 mA)—1,400 mA-s/week, and
3. spot films (75 to 110 kVp at 200 mA)—15,000 mA-s/week.

These work loads were used in estimating the weekly dose equivalent to the positions studied.

Scattered radiation measurements were made with either a Victoreen Model 440 survey meter or an Eberline Model RO–1 Rad Owl survey meter. If used properly, either instrument is energy independent for the photons measured in this study. All readings in mR/h were converted to mR/mA-s or mR/mA-min as required.

Results

The scattered radiation measurements made at eye level at each of the locations studied are presented in table 1. Also presented in table 1 are the estimated dose equivalents which are based upon the exposure rates and the given work loads for all related fluoroscopic procedures.



Layout of flouroscopy room and positions(A -E) potentially occupied by personnel during procedures.
Rectangle between positions A and E represents location of x-ray tube and image intensifier.

Figure 1. Layout of fluoroscopy room and positions potentially occupied by personnel during procedures

Table 1. Eye level scattered radiation measurements and weekly dose equivalents

Position	Exposure (mR/h)	Dose equivalent (mrem/week)
A	2.3	36
B	20	310
C	30	470
D	45	700
E	35	550

Note the different exposure rates associated with the various positions. Due to the lead drape and the location of the image intensifier some shielding is afforded location A. Location B also shows some lesser degree of shielding. But the remaining positions are out of the "shadow" of the image intensifier and, hence, are subjected to unattenuated scattered radiation.

It should be noted that similar measurements and calculations were also made at trunk (waist) level and were corrected for lead apron attenuation. As expected, these body measurements were much lower than the eye level dose equivalents given above.

Discussion

It should be recognized that the dose-equivalents given above are only representative of the dose to the eyes which would be received by personnel using this particular unit. It is unlikely that any one person would occupy a given position for the full operating time of this unit during a week. It is also true that many individuals (residents and student technologists) rotate through the department and will, therefore, not work in this particular room for a full year.

However, in those cases where there is no rotation of personnel because of limited staff (e.g., small hospitals or private offices) it is possible that dose equivalents to the lens of the eye may exceed 5 rem per year. For example, consider a technologist who occupies position C throughout one-fourth of the operating time for fluoroscopic procedures. With no eye protection and with 1 month's vacation, this person could receive 5,600 mrem in 1 year.

This is not unexpected when compared with the data of Malsky, et al. (*6*). Assume that a cardiologist receives an average of 18 mR to the eyes for a single full cardiac procedure. Let it be assumed that 10 such patients are handled each week. This could result in an average eye exposure to the cardiologist of 180 mR per week (assuming that the same individual performed all cathetherizations). This would result in a yearly exposure of 8,600 mrem. Again, it is not stated that this is the dose received by the lenses of this individual. Many factors could change the actual dose. For example, it may be demonstrated that wearing glasses can reduce the exposure to the eyes of people working in fluoroscopy (*8*).

A more recent study (*9*) has indicated much lower exposures for cardiac procedures than those reported by Malsky, et al. This points out the advisability of measuring eye level exposures with personnel monitors under actual conditions.

The question must also be asked as to whether this level of radiation dose from diagnostic energies of x rays would be sufficient to produce an effect in the eyes of individuals so exposed. The National Academy of Sciences Advisory Committee on the biological effects of ionizing radiations (the Beir Committee) suggests a high threshold dose for cataract formation (1,000 rads or more when delivered over a period of months), but does admit that studies with mice may indicate a lower threshold for lens opacities in that species (*10*).

Recent studies on lens changes brought about by protons and x rays on rabbits have also indicated a lower threshold dose particularly with radiations having LET's approaching those of diagnostic x-ray photons (*11*).

Many people working in fluoroscopy wear their film badges under the lead apron. Indeed many technologists have been trained to wear their badges in such locations (*12*). This is understandable since much emphasis has been placed upon the genetic effects of ionizing radiations.

It is felt that, until it can be established that a high threshold dose does exist for the radiation production of lens opacities in man, steps should be taken to prevent exposures to the eyes in excess of MPD. This may be accomplished by reducing the exposure time of personnel in the fluoroscopy room or providing some degree of eye shielding. It is also felt that every effort should be made to measure eye exposures under actual working conditions. If necessary, two dosimeters should be worn; one at eye level and one at waist level under the apron.

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Data

SECTION I. MILK AND FOOD

Milk Surveillance, April 1973

Although milk is only one of the sources of dietary intake of environmental radioactivity, it is the food item that is most useful as an indicator of the general population's intake of radionuclide contaminants resulting from environmental releases. Fresh milk is consumed by a large segment of the population and contains several of the biologically important radionuclides that may be released to the environment from nuclear activities. In addition, milk is produced and consumed on a regular basis, is convenient to handle and analyze, and samples representative of general population consumption can be readily obtained. Therefore, milk sampling networks have been found to be an effective mechanism for obtaining information on current radionuclide concentrations and long-term trends. From such information, public health agencies can determine the need for further investigation or corrective public health action.

The Pasteurized Milk Network (PMN) sponsored by the Office of Radiation Programs, Environmental Protection Agency, and the Office of Food Sanitation, Food and Drug Administration, Public Health Service, consists of 63 sampling stations: 61 located in the United States, one in Puerto Rico, and one in the Canal Zone. Many of the State health departments also conduct local milk surveillance programs which provide more comprehensive coverage within the individual State. Data from 16 of these State networks are reported routinely in *Radiation Data and Reports*. Additional networks for the routine surveillance of radioactivity in milk in the Western Hemisphere and their sponsoring organizations are:

Pan American Milk Sampling Program (Pan American Health Organization and U.S. Environmental Protection Agency)—7 sampling stations

Canadian Milk Network (Radiation Protection Division, Canadian Department of National Health and Welfare)—16 sampling stations.

The sampling locations that make up the networks presently reporting in *Radiation Data and Reports* are shown in figure 1. Based on the similar purpose for these sampling activities, the present format integrates the complementary data that are routinely obtained by these several milk networks.

Radionuclide and element coverage

Considerable experience has established that relatively few of the many radionuclides that are formed as a result of nuclear fission become incorporated in milk (*1*). Most of the possible radiocontaminants are eliminated by the selective metabolism of the cow, which restricts gastrointestinal uptake and secretion into the milk. The five fission-product radionuclides which commonly occur in milk are strontium-89, strontium-90, iodine-131, cesium-137, and barium-140. A sixth radionuclide, potassium-40, occurs naturally in 0.0118 percent (*2*) abundance of the element potassium, resulting in a specific activity for potassium-40 of 830 pCi/g total potassium.

Two stable elements which are found in milk, calcium and potassium, have been used as a means for assessing the biological behavior of metabolically similar radionuclides (radio-

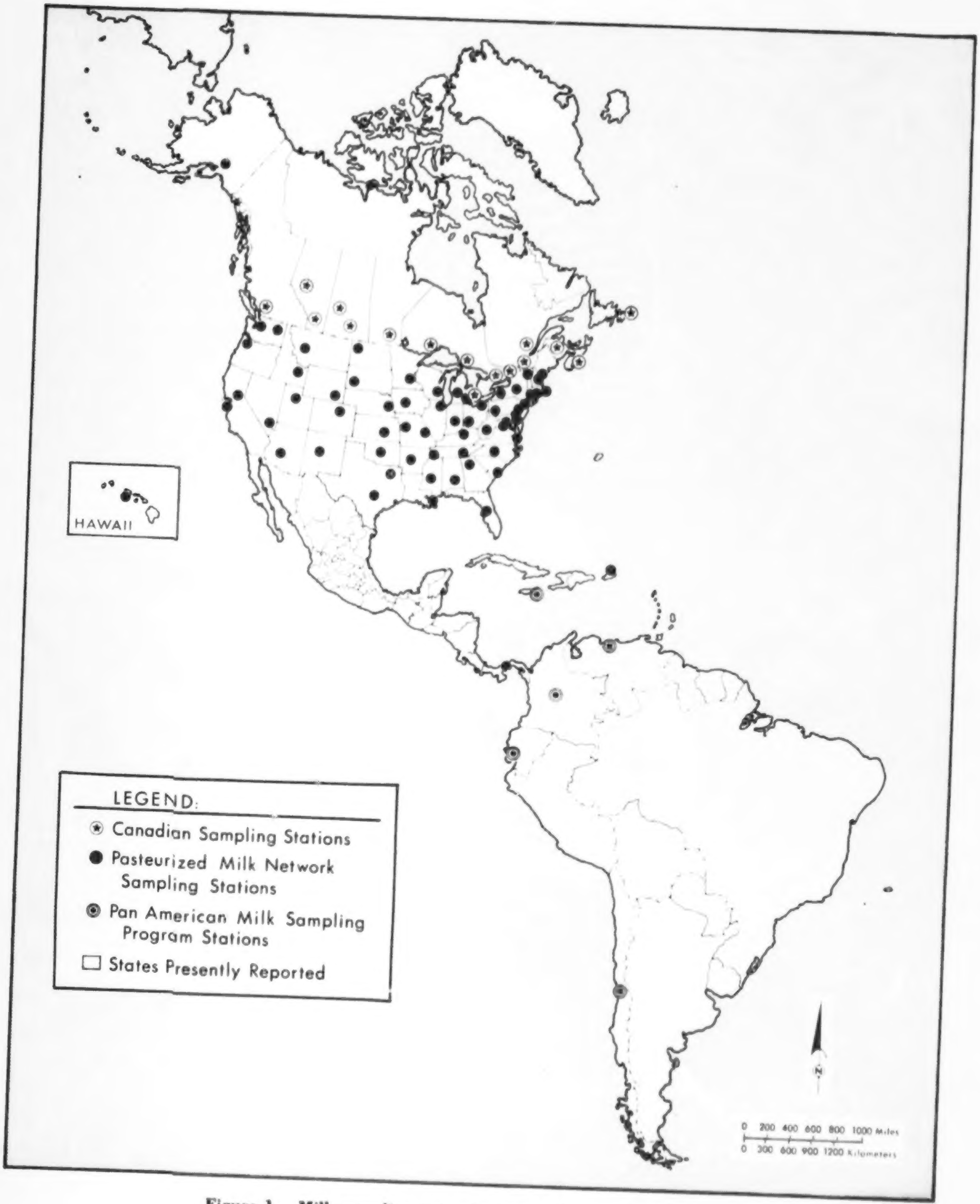
HAWAII
LEGEND:
⊛ Canadian Sampling Stations
● Pasteurized Milk Network Sampling Stations
◉ Pan American Milk Sampling Program Stations
☐ States Presently Reported
N
0 200 400 600 800 1000 Miles
0 300 600 900 1200 Kilometers

Figure 1. Milk sampling networks in the Western Hemisphere

strontium and radiocesium, respectively). The contents of both calcium and potassium in milk have been measured extensively and are relatively constant. Appropriate values and their variations, expressed in terms of 2 standard deviations (2σ), for these elements are 1.16 ± 0.08 g/liter for calcium and 1.51 ± 0.21 g/liter for potassium. These figures are averages of data from the PMN for May 1963–March 1966 (*3*) and are used for general radiation calculations.

Accuracy of data from various milk networks

In order to combine data from the international, national, and State networks considered in this report, it was first necessary to determine the accuracy with which each laboratory is making its determinations and the agreement of the measurements among the laboratories. The Analytical Quality Control Service of the Office of Radiation Programs conducts periodic studies to assess the accuracy of determinations of radionuclides in milk performed by interested radiochemical laboratories. The generalized procedure for making such a study has been outlined previously (*4*).

The most recent study was conducted during June 1972 with 37 laboratories participating in an experiment on a milk sample containing known concentrations of iodine-131, cesium-137, strontium-89, and strontium-90 (*5*). Of the 18 laboratories producing data for the network reports in *Radiation Data and Reports*, 14 participated in the study.

The accuracy results of this study for these 14 laboratories are shown in table 1. The accuracy of the cesium-137 measurements continues to be excellent as in previous experiments. However, both the accuracy and precision need to be improved for iodine-131, strontium-89, and strontium-90 which could probably be accomplished through recalibration.

Development of a common reporting basis

Since the various networks collect and analyze samples differently, a complete understanding of several parameters is useful for interpreting the data. Therefore, the various milk surveillance networks that report regularly were surveyed for information on analytical methods, sampling and analysis frequencies, and estimated analytical errors associated with the data.

In general, radiostrontium is collected by an ion-exchange technique and determined by beta-particle counting in low-background detectors, and the gamma-ray emitters (potassium-40, iodine-131, cesium-137, and barium-140) are determined by gamma-ray spectroscopy of whole milk. Each laboratory has its own modifications and refinements of these basic methodologies.

Many networks collect and analyze samples on a monthly basis. Some collect samples more frequently but composite the several samples for one analysis, while others carry out their analyses more often than once a month. Many networks are analyzing composite samples on a quarterly basis for certain nuclides. The frequency of collection and analysis varies not only among the networks but also at different stations within some of the networks. In addi-

Table 1. Distribution of mean results, quality control experiment

Isotope and known concentration	Number of laboratories in each category				Experimental 2σ error (pCi/liter)
	Acceptable [a]	Warning level [b]	Unacceptable [c]	Total	
Iodine-131 (96 or 99 pCi/liter)	7 (58%)	1 (8%)	4 (33%)	12	6
Iodine-131 (438 or 484 pCi/liter)	11 (85%)	0	2 (15%)	13	25 or 28
Cesium-137 (53 or 54 pCi/liter)	11 (92%)	0	1 (8%)	12	6
Cesium-137 (295 or 303 pCi/liter)	11 (85%)	2 (15%)	0	13	17
Strontium-89 (29 or 30 pCi/liter)	9 (82%)	0	2 (18%)	11	6
Strontium-89 (197 or 201 pCi/liter)	3 (33%)	1 (11%)	5 (56%)	9	11 or 12
Strontium-90 (32.1 or 32.4 pCi/liter	4 (33%)	4 (33%)	4 (33%)	12	1.9
Strontium-90 (150.5 or 151.2 pCi/liter)	6 (55%)	0	5 (45%)	11	8.7

[a] Measured concentration equal to or within 2σ of the known concentration.
[b] Measured concentration outside 2σ and equal to or within 3σ of the known concentration.
[c] Measured concentration outside 3σ of the known concentration.

tion, the frequency of collection and analysis is a function of current environmental levels. The number of samples analyzed at a particular sampling station under current conditions is reflected in the data presentation. Current levels for strontium-90 and cesium-137 are relatively stable over short periods of time, and sampling frequency is not critical. For the short-lived radionuclides, particularly iodine-131, the frequency of analysis is critical and is generally increased at the first measurement or recognition of a new influx of this radionuclide.

The data in table 2 show whether raw or pasteurized milk was collected. An analysis (*6*) of raw and pasteurized milk samples collected during January 1964 to June 1966 indicated that for relatively similar milkshed or sampling areas, the differences in concentration of radionuclides in raw and pasteurized milk are not statistically significant (*6*). Particular attention was paid to strontium-90 and cesium-137 in that analysis.

Practical reporting levels were developed by the participating networks, most often based on 2-standard-deviation counting errors or 2-standard-deviation total analytical errors from replicate analyses (*3*). The practical reporting level reflects analytical factors other than statistical radioactivity counting variations and will be used as a practical basis for reporting data.

The following practical reporting levels have been selected for use by all networks whose practical reporting levels were given as equal to or less than the given value.

Radionuclide	Practical reporting level (pCi/liter)
Strontium-89	5
Strontium-90	2
Iodine-131	10
Cesium-137	10
Barium-140	10

Some of the networks gave practical reporting levels greater than those above. In these cases the larger value is used so that only data considered by the network as meaningful will be presented. The practical reporting levels apply to the handling of individual sample determinations. The treatment of measurements equal to or below these practical reporting levels for calculation purposes, particularly in calculating monthly averages, is discussed in the data presentation.

Analytical error or precision expressed as pCi/liter or percent in a given concentration range has also been reported by the networks (*3*). The precision errors reported for each of the radionuclides fall in the following ranges:

Radionuclide	Analytical errors of precision (2 standard deviations)
Strontium-89	1–5 pCi/liter for levels <50 pCi/liter; 5–10% for levels ≧ 50 pCi/liter;
Strontium-90	1–2 pCi/liter for levels <20 pCi/liter; 4–10% for levels ≧ 20 pCi/liter;
Iodine-131 Cesium-137 Barium-140	4–10 pCi/liter for levels <100 pCi/liter; 4–10% for levels ≧ 100 pCi/liter.

For iodine-131, cesium-137, and barium-140, there is one exception for these precision error ranges: 25 pCi/liter at levels <100 pCi/liter for Colorado. This is reflected in the practical reporting level for the Colorado milk network.

Federal Radiation Council guidance applicable to milk surveillance

In order to place the U.S. data on radioactivity in milk presented in *Radiation Data and Reports* in perspective, a summary of the guidance provided by the Federal Radiation Council for specific environmental conditions was presented in the February 1973 issue of *Radiation Data and Reports.*

Data reporting format

Table 2 presents the integrated results of the international, national, and State networks discussed earlier. Column 1 lists all the stations which are routinely reported in *Radiation Data and Reports*. The relationship between the PMN stations and the State stations is shown

Table 2. Concentrations of radionuclides in milk for April 1973 and 12-month period, May 1972 through April 1973

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:						
Ala:	Montgomery [c]	P	5	5	12	6
Alaska:	Palmer [c]	P	4	4	0	2
Ariz:	Phoenix [c]	P	0	0	0	0
Ark:	Little Rock [c]	P	9	9	12	3
Calif:	Sacramento [c]	P	2	1	0	0
	San Francisco [c]	P	0	0	0	0
	Del Norte	P	14	11	0	7
	Fresno	P	0	1	0	2
	Humboldt	P	4	3	0	2
	Los Angeles	P	2	1	0	2
	Mendocino	P	3	2	0	4
	Sacramento	P	2	2	0	3
	San Diego	P	2	1	0	3
	Santa Clara	P	0	2	0	2
	Shasta	P	2	2	0	5
	Sonoma	P	3	2	0	3
Colo:	Denver [c]	P	3	3	0	0
	East	R	NS	NA	NS	7
	Northeast	R	NS	NA	NS	1
	Northwest	R	NA	NA	[d] 0 (2)	0
	South Central	R	NS	NS	NS	
	Southeast	R	NA	NA	NS	0
	Southwest	R	NA	NA	[d] 0	2
	West	R	NA	NA	NS	3
Conn:	Hartford [c]	P	4	5	0	3
	Central	P	NA		NA	
Del:	Wilmington [c]	P	3	7	0	7
D.C:	Washington [c]	P	2	5	0	3
Fla:	Tampa [c]	P	4	4	33	33
	Central	R	5	5	23	38
	North	R	8	6	23	14
	Northeast	R	6	5	29	32
	Southeast	R	6	5	28	46
	Tampa Bay area	P	5	5	43	34
	West	R	7	8	0	9
Ga:	Atlanta [c]	P	NS	8	0	9
Hawaii:	Honolulu [c]	P	0	1	0	0
Idaho:	Idaho Falls [c]	P	0	3	0	0
Ill:	Chicago [c]	P	3	5	0	4
Ind:	Indianapolis [c]	P	5	4	0	1
	Central	P	6	7	10	9
	Northeast	P	4	6	10	8
	Northwest	P	6	8	15	10
	Southeast	P	6	7	0	7
	Southwest	P	7	7	0	10
Iowa:	Des Moines [c]	P	5	5	0	0
	Iowa City	P	5	6	0	5
	Des Moines	P	5 (2)	5	0 (2)	3
	Little Cedar	P	NS	4	0	2
	Spencer	P	7	6	0	3
Kans	Wichita [c]	P	4	5	0	0
	Coffeyville	P	7	8	9	9
	Dodge City	P	3	5	4	5
	Falls City, Nebr	P	NS	-	NS	-
	Hays	P	6	9	7	7
	Kansas City	P	4	8	7	8
	Topeka	P	5	7	5	5
	Wichita	P	6	8	11	10
Ky:	Louisville [c]	P	4	6	0	2
La:	New Orleans [c]	P	11	11	0	1
Maine:	Portland [c]	P	0	5	16	19
Md:	Baltimore [c]	P	4	6	12	4
Mass:	Boston [c]	P	6	6	11	13
Mich:	Detroit [c]	P	6	6	13	5
	Grand Rapids [c]	P	6	7	0	1
	Bay City	P	14	5	0 (2)	2
	Charlevoix	P	8	5	0 (4)	6
	Detroit	P	6	4	0	3
	Grand Rapids	P	7	5	0	4
	Lansing	P	10	4	0 (2)	5
	Marquette	P	8	5	17 (2)	12
	Monroe	P	5	3	0 (2)	1
	South Haven	P	7	5	0 (4)	6
Minn:	Minneapolis [c]	P	6	7	0	9
	Bemidji	P	5	6	15	13
	Duluth	P	16	15	24	24
	Fergus Falls	P	7	7	15	11
	Little Falls	P	12	17	10	37
	Mankato	P	4	5	0	0
	Marshall	P	0	4	0	0

See footnotes at end of table.

Table 2. Concentrations of radionuclides in milk for April 1973 and 12-month period, May 1972 through April 1973—continued

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:—continued						
Minn:	Minneapolis	P	9	9	15	13
	Rochester	P	7	7	20	0
Miss:	Jackson [c]	P	8	8	14	8
Mo:	Kansas City [c]	P	5	5	0	0
	St. Louis [c]	P	8	6	0	1
Mont:	Helena [c]	P	4	4	0	0
Nebr:	Omaha [c]	P	5	4	0	0
Nev:	Las Vegas [c]	P	2	1	0	0
N.H:	Manchester [c]	P	4	6	12	14
N.J:	Trenton [c]	P	6	6	0	5
N. Mex:	Albuquerque [c]	P	0	0	0	0
N.Y:	Buffalo [c]	P	4	5	12	4
	New York City [c]	P	4	8	0	4
	Syracuse [c]	P	5	6	0	3
	Albany	P	2	4	0 (4)	0
	Buffalo	P	6	5	0	0
	Massena	P	4	7	0	0
	New York City	P	NA	6	0	0
	Syracuse	P	12	5	0	0
N.C:	Charlotte [c]	P	6	7	12	5
N. Dak:	Minot [c]	P	6	8	0	2
Ohio:	Cincinnati [c]	P	4	5	0	2
	Cleveland [c]	P	6	6	0	3
Okla:	Oklahoma City [c]	P	3	4	0	1
Oreg:	Portland [c]	P	4	4	0	3
	Baker	P	NA		0	2
	Coos Bay	P	NA		12	7
	Eugene	P	NA		0	0
	Medford	P	NA		13	9
	Portland composite	P	NA		0	2
	Portland local	P	NA		0	1
	Redmond	P	NA		11	3
	Tillamook	R	NA		21	12
Pa:	Philadelphia [c]	P	5	6	0	3
	Pittsburgh [c]	P	8	8	0	6
	Dauphin	P	6		0	4
	Erie	P	NS		NS	8
	Philadelphia	P	NS		NS	6
	Pittsburgh	P	NS		NS	5
R.I:	Providence [c]	P	5	5	0	10
S.C:	Charleston [c]	P	6	7	0	8
	Chapin	R	NS	8	NS	14
	Clemson	R	8	8	8	8
	Columbia	R	9	9	13	13
	Fairfield	R	NS	6	NS	18
	Hartsville-02	R	7	6	15	15
	Hartsville-03	R	NS	17	NS	18
	Lee County	R	7	8	20	19
	Oconee County	R	NS	8	NS	12
	Pickens	R	NS	7	NS	12
	Williston	R	NS	8	NS	16
	Winnsboro	R	NS	9	NS	10
S. Dak:	Rapid City [c]	P	4	5	0	1
Tenn:	Chattanooga [c]	P	7	8	0	6
	Memphis [c]	P	5	6	0	1
	Chattanooga	P	NA	9	0	7
	Clinton	R	NA	8	9 (2)	8
	Fayetteville	R	NA	8	18 (2)	7
	Kingston	R	NA	8	0	2
	Knoxville	P	NA	7	0 (2)	3
	Lawrenceburg	R	NS	6	NS	8
	Nashville	P	4	7	0	4
	Pulaski	R	NA	6	0 (2)	5
	Sequoyah	R	NS	7	NS	13
Tex:	Austin [c]	P	0	2	0	0
	Dallas [c]	P	5	5	0	0
	Amarillo	R	NA		NA	
	Corpus Christi	R	NA		NA	
	El Paso	R	NA		NA	
	Fort Worth	R	NA		NA	
	Harlingen	R	NA		NA	
	Houston	R	NA		NA	
	Lubbock	R	NA		NA	
	Midland	R	NA		NA	
	San Antonio	R	NA		NQ	
	Texarkana	R	NA		NA	
	Uvalde	R	NA		NA	
	Wichita Falls	R	NA		NA	

See footnotes at end of table.

Table 2. Concentrations of radionuclides in milk for April 1973 and 12-month period, May 1972 through April 1973—continued

Sampling location	Type of sample [a]	Radionuclide concentration (pCi/liter)			
		Strontium-90		Cesium-137	
		Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:					
Utah: Salt Lake City [c]	P	0	3	0	2
Vt: Burlington [c]	P	4	5	11	8
Va: Norfolk [c]	P	5	6	0	5
Wash: Seattle [c]	P	2	4	0	1
Spokane [c]	P	6	4	0	2
Benton County	R	NS	1	NS	0
Franklin County	R	0	1	0	0
Longview	R	3	4	11	2
Sandpoint, Idaho	R	6	7	0	5
Skagit County	R	3	7	0	4
W. Va: Charleston [c]	P	6	7	0	3
Wisc: Milwaukee [c]	P	5	5	0	5
Wyo: Laramie [c]	P	3	2	0	0
CANADA:					
Alberta: Calgary	P	NA		10	12
Edmonton	P	NA		15	17
British Columbia:					
Vancouver	P	NA		16	17
Manitoba:					
Winnipeg	P	NA		7	13
New Brunswick:					
Moncton	P	NA		6	8
Newfoundland:					
St. John's	P	NA		15	22
Nova Scotia:					
Halifax	P	NA		17	13
Ontario: Ottawa	P	NA		4	8
Sault Ste. Marie	P	NA		15	19
Thunder Bay	P	NA		18	17
Toronto	P	NA		2	8
Windsor	P	NA		3	7
Quebec: Montreal	P	NA		11	8
Quebec	P	NA		15	16
Saskatchewan:					
Regina	P	NA		15	10
Saskatoon	P	NA		6	10
CENTRAL AND SOUTH AMERICA:					
Canal Zone:					
Cristobal [c]	P	0	1	0	15
Chile: Santiago	P	0	1	0	1
Colombia: Bogota	P	0	0	0	0
Ecuador: Guayaquil	P	0	0	0	0
Jamaica: Kingston	P	0	2	21	49
Puerto Rico:					
San Juan [c]	P	3	1	0	2
Venezuela:					
Caracas	P	0(2)	0	6(2)	1
PMN network average [e]		4	5	3	4

[a] P, pasteurized milk.
R, raw milk.

[b] When an individual sampling result was equal to or less than the practical reporting level, a value of "0" was used for averaging. Monthly averages less than the practical reporting level reflect the fact that some but not all of the individual samples making up the average contained levels greater than the practical reporting level. When more than one analysis was made in a monthly period, the number of samples in the monthly average is given in parentheses.

[c] Pasteurized Milk Network station. All other sampling locations are part of the State or National network.

[d] The practical reporting level for this network differs from the general ones given in the text. Sampling results for these networks were equal to or less than the following practical reporting levels:
Cesium-137: Colorado—25 pCi/liter.

[e] This entry gives the average radionuclide concentrations for the Pasteurized Milk Network stations denoted by footnote [c].
NA, no analysis.
NS, no sample collected.

in figure 2. The first column in table 2 under each of the reported radionuclides gives the monthly average for the station and the number of samples analyzed in that month in parentheses. When an individual sampling result is equal to or below the practical reporting level for the radionuclide, a value of zero is used for averaging. Monthly averages are calculated using the above convention. Averages which are equal to or less than the practical reporting levels reflect the presence of radioactivity in some of the individual samples

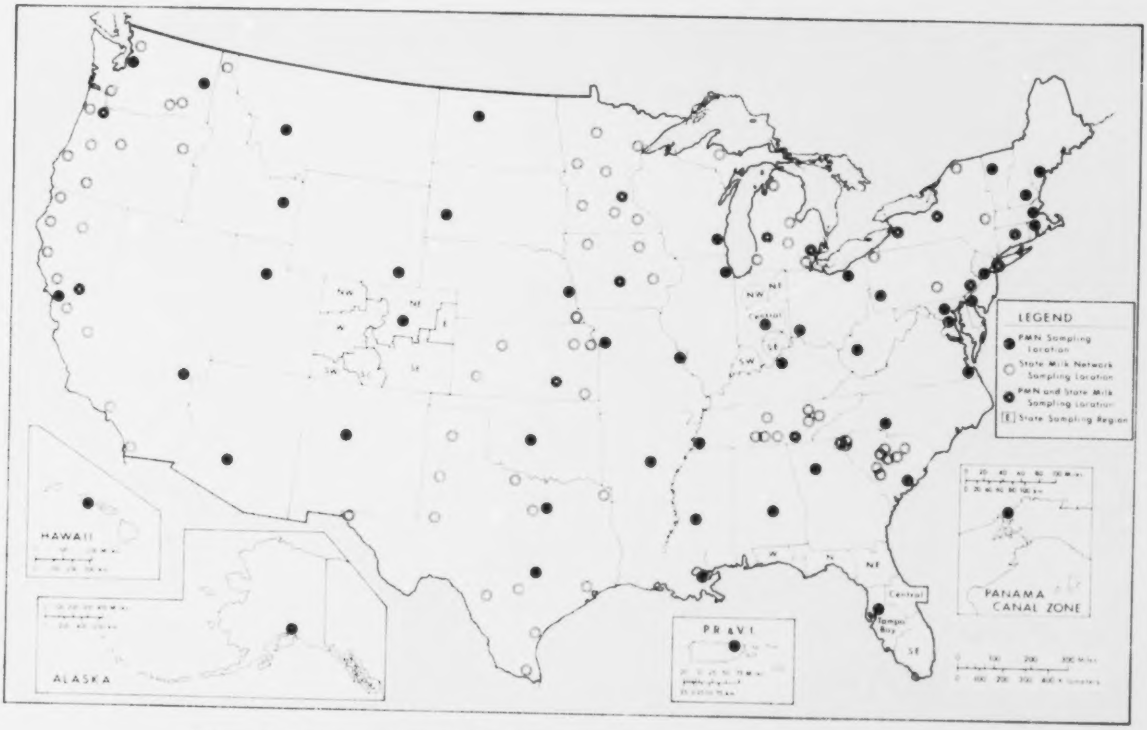
LEGEND
PMN Sampling location
State Milk Network Sampling location
PMN and State Milk Sampling location
State Sampling Region
NW
NE
SW
SE
W
Central
HAWAII
ALASKA
PR & VI
PANAMA CANAL ZONE
Tampa Bay

Figure 2. State and PMN milk sampling stations in the United States

greater than the practical reporting level.

The second column under each of the radionuclides reported gives the 12-month average for the station as calculated from the preceding 12 monthly averages, giving each monthly average equal weight. Since the daily intake of radioactivity by exposed population groups, averaged over a year, constitutes an appropriate criterion for the case where the FRC radiation protection guides apply, the 12-month average serves as a basis for comparison.

Discussion of current data

In table 2, surveillance results are given for strontium-90 and cesium-137 for April 1973 and the 12-month period, May 1972 to April 1973. Except where noted, the monthly average represents a single sample for the sampling station. Strontium-89, iodine-131, and barium-140 data have been omitted from table 2 since levels at all stations for April 1973 were below the respective practical reporting levels.

Strontium-90 monthly averages ranged from 0 to 16 pCi/liter in the United States for April 1973 and the highest 12-month average was 17 pCi/liter (Little Falls, Minn; and Hartsville, S.C.[1]) representing 8.5 percent of the Federal Radiation Council radiation protection guide. Cesium-137 monthly averages ranged from 0 to 43 pCi/liter in the United States for April 1973, and the highest 12-month average was 46 pCi/liter (Southeast Florida) representing 1.3 percent of the value derived from the recommendations given in the Federal Radiation Council report.

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[1] Average of 5 months.

Acknowledgement

Appreciation is expressed to the personnel of the following agencies who provide data from their milk surveillance networks:

Bureau of Radiological Health
Environmental Health & Consumer Protection Program
California Department of Public Health

Radiation Protection Division
Canadian Department of National Health and Welfare

Radiological Health Section
Division of Occupational and Radiological Health
Colorado Department of Health

Radiological Health Services
Division of Medical Services
Connecticut State Department of Health

Radiological and Occupational Health Section
Department of Health and Rehabilitative Services
State of Florida

Bureau of Environmental Sanitation
Division of Sanitary Engineering
Indiana State Board of Health

Division of Radiological Health
Environmental Engineering Services
Iowa State Department of Health

Radiation Control Section
Environmental Health Division
Kansas State Department of Health

Radiological Health Services
Division of Occupational Health
Michigan Department of Health

Radiation Control Section
Division of Environmental Health
State of Minnesota Department of Health

Bureau of Radiological Pollution Control
New York State Department of Environmental Conservation

Environmental Radiation Surveillance Program
Division of Sanitation and Engineering
Oregon State Board of Health

Radiological Health Section
Bureau of Environmental Health
Pennsylvania Department of Public Health

Division of Radiological Health
South Carolina State Board of Health

Radiological Health Services
Division of Preventable Diseases
Tennessee Department of Public Health

Division of Occupational Health
Environmental Health Services
Texas State Department of Health

Radiation Control Section
Division of Health
Washington Department of Social and Health Services

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Milk Surveillance Network, February 1973

National Environmental Research Center—
Las Vegas, Environmental Protection Agency

The Milk Surveillance Network operated by the NERC-LV consists of 24 routine and two alternate sampling locations (figure 1) situated in the offsite area surrounding the Nevada Test Site (NTS). This routine network is operated in support of the nuclear testing sponsored by[1] the U.S. Atomic Energy Commission (AEC) at the Nevada Test Site (NTS).

In the event of a release of radioactivity from the NTS, special sampling within the affected

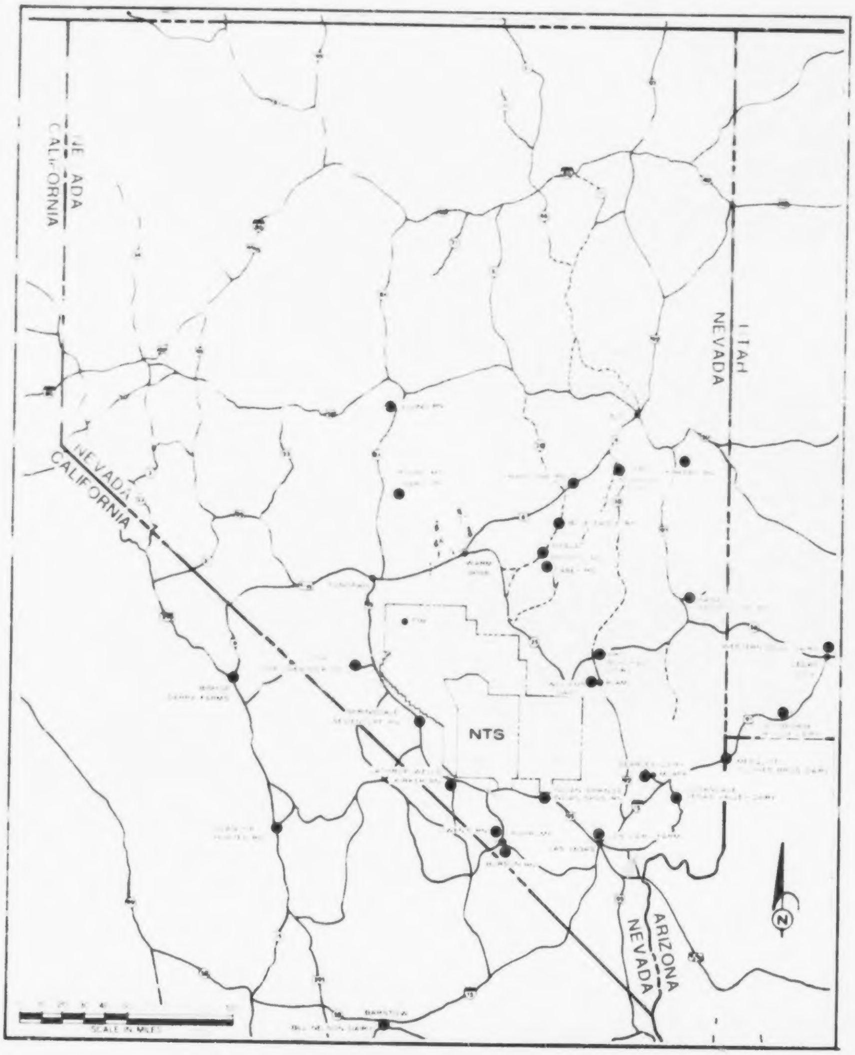
NEVADA
CALIFORNIA
UTAH
NEVADA
NEVADA
CALIFORNIA
NTS
ARIZONA
NEVADA
N
SCALE IN MILES
BARSTOW

Figure 1. NERC–LV milk surveillance network

area is conducted to determine radionuclide concentrations and to take protective action, if required. Additional milk sampling networks are operated in support of AEC operations in areas other than the NTS when requested. A complete description of sampling and analytical procedures was included with the milk results reported in the July 1973 issue of *Radiation Data and Reports.*

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[1] This network is operated under a Memorandum of Understanding (No. AT(26-1)-539) with the Nevada Operations Office, U.S. AEC, Las Vegas, Nev.

Results

The analytical results of all milk samples collected in February 1973 by NERC-LV surveillance programs are listed in table 1. With the exception of cesium-137 at levels near the minimum detectable activity (MDA) of 10 pCi/liter, no gamma-emitting fission products were identified by gamma spectrometry in any of the samples collected in February. Levels of tritium near the MDA for this radionuclide (200 pCi/liter) were also measured by radiochemistry analyses. The highest concentration of tritium during February was 490 ± 260 pCi/liter. In order to economize operations, the frequency of strontium-89 and strontium-90 analysis on routine samples was changed from

Table 1. Milk surveillance results, February 1973

Location	Date collected	Sample type [a]	Radionuclide concentrations [b] (pCi/liter)			
			Cesium-137	Strontium-89	Strontium-90	Tritium
California:						
Bishop:						
Sierra Farms	2/2	11	10	NA	NA	NA
Hinkley:						
Bill Nelson Dairy	2/1	12	[c] <100	NA	NA	NA
Olancha:						
Hunter Ranch	2/2	13	[c] <100	NA	NA	NA
Nevada:						
Alamo:						
Williams Dairy	2/5	12	<10	NA	NA	NA
Austin:						
Young's Ranch	2/5	13	<10	NA	NA	470 ± 240
Currant:						
Blue Eagle Ranch	NS					
Manzonie Ranch	2/7	13	<10	NA	NA	NA
Hiko:						
Schofield Dairy	2/5	12	<10	NA	NA	<230
Indian Springs:						
Indian Springs Ranch	2/14	13	<10	NA	NA	NA
Las Vegas:						
LDS Dairy Farms	2/9	12	<10	NA	NA	<230
Lathrop Wells:						
Kirker Ranch	2/13	13	<10	NA	NA	NA
Lida:						
Lida Livestock Company	2/4	13	[c] <100	NA	NA	NA
Logandale:						
Vegas Valley Dairy	2/7	12	<10	NA	NA	NA
Lund:						
McKenzie Dairy	2/8	12	<10	NA	NA	<230
Mesquite:						
Hughes Bros. Dairy	2/5	12	<10	NA	NA	420 ± 260
Moapa:						
Searles Dairy	2/7	12	<10	NA	NA	NA
Nyala:						
Sharp's Ranch	2/8	13	[c] <100	<2	5.0 ± 1.4	490 ± 260
Pahrump:						
Owens Ranch	2/14	13	<10	NA	NA	NA
Panaca:						
Kenneth Lee Ranch	2/4	13	<10	NA	NA	NA
Round Mountain:						
Berg Ranch	2/5	13	<10	NA	NA	NA
Shoshone:						
Kirkeby Ranch	2/9	13	<10	NA	NA	NA
Springdale:						
Seidentopf Ranch	2/13	13	<10	NA	NA	NA
Utah:						
Cedar City:						
Western Gold Dairy	2/6	12	<10	NA	NA	NA
St. George:						
R. Cox Dairy	2/5	12	<10	NA	NA	NA

[a] 11—Pasteurized milk.
12—Raw milk from Grade A producer(s).
13—Raw milk from family cow(s).
[b] Two-sigma counting error provided when available.
[c] Small sample size increased minimum detectable activity.
NA, no analysis.
NS, no sample.

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monthly to quarterly effective January 1, 1973. Because the sample collected at Nyala, Nev. in January was sour, the February sample was analyzed. The concentrations of strontium-89 and strontium-90 for this sample were <2 and 5.0 ± 1.4 pCi/liter, respectively.

Food and Diet Surveillance

Efforts are being made by various Federal and State agencies to estimate the dietary intake of selected radionuclides on a continuing basis. These estimates, along with the guidance developed by the Federal Radiation Council, provide a basis for evaluating the significance of radioactivity in foods and diet.

Networks presently in operation and reported routinely include those listed below. These networks provide data useful for developing estimates of nationwide dietary intake of radionuclides. Programs reported in *Radiation Data and Reports* are as follows:

Program	Period reported	Issue
California Diet Study	January–June 1971	December 1972
Carbon-14 in Total Diet and Milk	July–December 1971	May 1972
Institutional Diet Samples	April–June 1972	July 1973
Radiostrontium in Milk	January–December 1971	November 1972
Strontium-90 in Tri-City Diets	January–December 1971	December 1972

Radionuclides in Institutional Diet Samples July–September 1972

Environmental Protection Agency and Food and Drug Administration

The determination of radionuclide concentrations in the diet constitutes an important element of an integrated program of environmental radiological surveillance and assessment. Recognizing that the diet is a potentially significant contribution to total environmental radiation exposures, the Public Health Service initiated its Institutional Diet Sampling Program in 1961. The program is now administered by the Office of Radiation Programs, Environmental Protection Agency with the assistance of the Office of Food Sanitation, Food and Drug Administration, Department of Health, Education and Welfare (*1*).

This program estimates the dietary intake of radionuclides in a selected population group, ranging from children to young adults of school age. At present 26 institutions—distributed geographically as shown in figure 1—are being sampled. Previous results showed that the daily

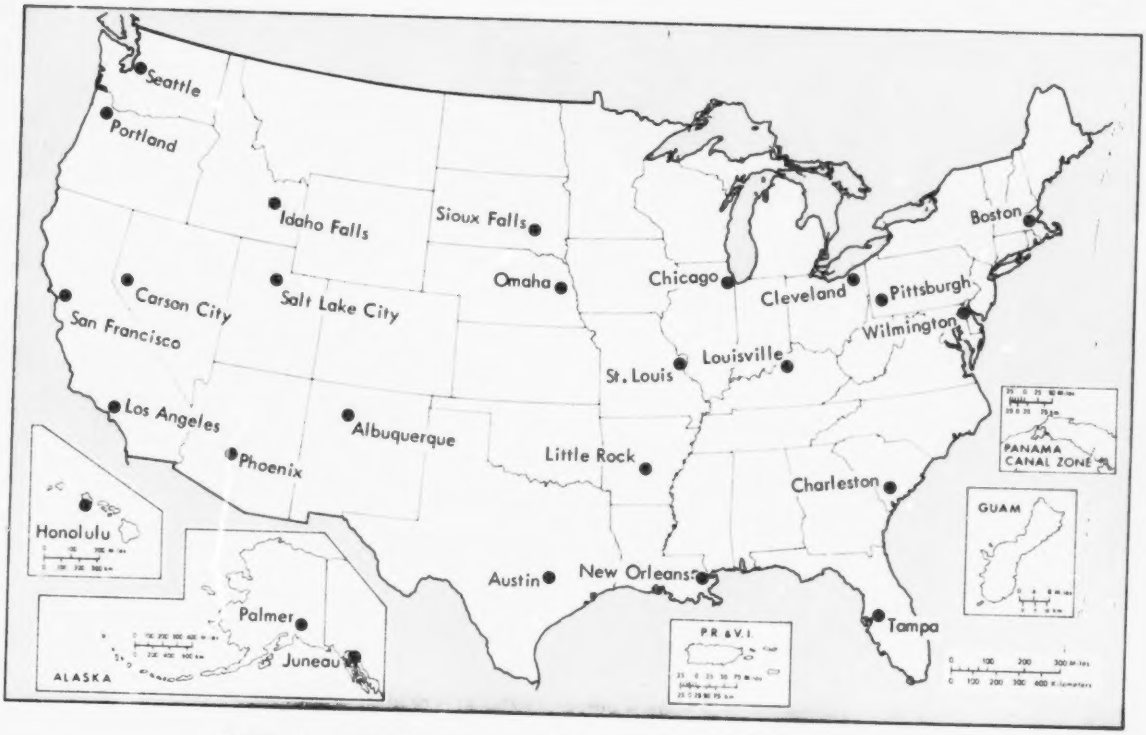
Seattle
Portland
Idaho Falls
Sioux Falls
Boston
Carson City
Salt Lake City
Omaha
Chicago
Cleveland
Pittsburgh
San Francisco
Wilmington
Louisville
St. Louis
Los Angeles
Albuquerque
Little Rock
PANAMA CANAL ZONE
Phoenix
Charleston
GUAM
Honolulu
Austin
New Orleans
Palmer
Tampa
PR & V.I.
Juneau
ALASKA

Figure 1. Institutional diet sampling locations as of September 1972

dietary intake of teenage girls and children from 9 to 12 years of age were comparable, but teenage boys consumed 20 percent more food per day (*1,2*). Extrapolating this information, estimates for teenage boys and/or girls can be calculated on the basis of the dietary intake of children.

The sampling procedure is generally the same at each institution. Each sample represents the edible portion of the diet for a full 7-day week (21 meals plus between-meal snacks), obtained by duplicating the food intake of a different individual daily. Drinking water—which is not included—is also sampled periodically. Each daily sample is kept frozen until the end of the collection period. It is then packed in dry ice and shipped by air to either the National Environmental Research Center, Las Vegas, Nev. or the Eastern Environmental Radiation Facility, Montgomery, Ala. A detailed description of sampling and analytical procedures has already been presented in *Radiological Health Data and Reports* (*3*).

Results

Table 1 shows the analytical results for institutional diet samples collected from all stations during July–September 1972. The stable elements, calcium and potassium, are reported in g/kg of diet. Where applicable, radionuclide concentrations of these samples reported in pCi/kg of diet are corrected for radioactive decay to the midpoint of the sample collection period. Dietary intakes in g/day or pCi/day were obtained by multiplying the food consumption rate in kg/day by the appropriate concentration values. The average food consumption rate during this period was 1.68 kg/day compared to the network average of 1.85 kg/day observed from 1961 through 1971.

Strontium-90 dietary intake averaged 9 pCi/day during this period. Cesium-137 intake averaged 4 pCi/day. These results fall within Range I as defined by the former Federal Radiation Council (*4*). Barium-140 and iodine-131 concentrations were below detectable levels.

Table 1. Concentration and intake of stable elements and radionuclides in institutional total diets of children July–September 1972

Location of institution		Month [a] (1972)	Total weight (kg/day)	Calcium		Potassium		Strontium-90		Cesium-137	
				(g/kg)	(g/day)	(g/kg)	(g/day)	(pCi/kg)	(pCi/day)	(pCi/kg)	(pCi/day)
Alaska:	Juneau	July	1.42	0.8	1.1	1.6	2.3	4	5	14	20
	Palmer	Aug [b]	1.84	.5	1.0	1.7	3.1	5	10	0	0
Ariz:	Phoenix	July	1.51	.4	.7	2.0	3.0	4	6	0	0
Ark:	Little Rock	July	1.36	.5	.6	1.6	2.2	9	12	0	0
Calif:	Los Angeles		NS								
	San Francisco	July [b]	1.85	.6	1.1	1.7	3.1	4	7	0	0
Del:	Wilmington	July [b]	.82	.8	.7	1.4	1.2	5	4	0	0
Fla:	Tampa	Sept	1.80	.7	1.2	1.4	2.6	6	10	24	43
Hawaii:	Honolulu	July	2.17	.5	1.1	1.7	3.7	3	7	0	0
Idaho:	Idaho Falls	July [b]	1.69	.6	1.0	1.6	2.6	7	12	11	19
Ill:	Chicago		NS								
Ky:	Louisville	July [b]	2.70	.9	2.4	1.6	4.3	7	19	0	0
La:	New Orleans	July [b]	1.35	.6	.9	1.8	2.4	8	11	0	0
Mass:	Boston	July [a]	2.56	.6	1.5	1.2	3.2	5	13	0	0
Mo:	St. Louis	July	.84	.5	.4	2.1	1.8	4	4	0	0
Nebr:	Omaha	July [a]	1.71	.5	.8	1.8	3.0	6	11	0	0
Nev:	Carson City	July	1.22	.7	.8	1.7	2.1	2	3	0	0
N. Mex:	Albuquerque	Aug [b]	1.91	.6	1.1	1.8	3.4	4	8	0	0
Ohio:	Cleveland	Sept [b]	.66	.5	.3	1.2	.8	6	4	0	0
Oreg:	Portland	July [b]	2.01	.4	.8	1.7	3.4	8	17	0	0
Pa:	Pittsburgh	July	3.19	.5	1.7	1.3	4.3	7	22	0	0
S.C:	Charleston	July [b]	1.82	.7	1.3	1.3	2.4	7	12	11	20
S. Dak:	Sioux Falls	July [b]	1.10	.6	.7	1.4	1.5	9	10	0	0
Tex:	Austin	July [b]	1.17	.6	.8	1.1	1.3	3	4	0	0
Utah:	Salt Lake City	July [b]	1.95	.4	.7	1.9	3.7	4	8	0	0
Wash:	Seattle	July [b]	1.78	.5	.9	1.8	3.1	0	0	0	0
Institutional average			1.68	0.6	1.0	1.6	2.7	5	9	3	4

[a] Quarterly sample usually collected the first month of the quarter.

[b] Food samples were collected from two or more children who were not between the ages of 9 and 12.

NOTE: Iodine-131 and barium-140 were not detected at any station during this period. Juneau, Alaska, had a strontium-89 concentration of 6 pCi/kg or 9 pCi/day and Seattle, Wash., had a strontium-89 concentration of 7 pCi/kg or 12 pCi/day.

NS, no sample.

Strontium-89 was detected in Juneau, Alaska, and Seattle, Wash.

All concentrations less than or equal to the appropriate minimum detectable level have been reported as zero. The minimum detectable concentration is defined as the measured concentration equal to the 2 standard-deviation analytical error. Accordingly, the minimum detectable limits are strontium-89, 5 pCi/kg; strontium-90, 2 pCi/kg; iodine-131, 10 pCi/kg; barium-140, 10 pCi/kg; cesium-137, 10 pCi/kg.

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Recent coverage in *Radiation Data and Reports:*

Period	Issue
July–September 1971	April 1972
October–December 1971	June 1972
January–March 1972	June 1973
April–June 1972	July 1973

SECTION II. WATER

The Environmental Protection Agency and other Federal, State, and local agencies operate extensive water quality sampling and analysis programs for surface, ground, and treated water. Most of these programs include determinations of gross beta and gross alpha radioactivity and specific radionuclides.

Although the determination of the total radionuclide intake from all sources is of primary importance, a measure of the public health importance of radioactivity levels in water can be obtained by comparison of the observed values with the Public Health Service Drinking Water Standards (*1*). These standards, based on consideration of Federal Radiation Council (FRC) recommendations (*2–4*) set the limits for approval of a drinking water supply containing radium-226 and strontium-90 at 3 pCi/liter and 10 pCi/liter, respectively. Higher concentrations may be acceptable if the total intake of radioactivity from all sources remains within the guides recommended by FRC for control action. In the known absence[1] of strontium-90 and alpha-particle emitters, the limit is 1,000 pCi/liter gross beta radioactivity, except when additional analysis indicates that concentrations of radionuclides are not likely to cause exposures greater than the limits indicated by the Radiation Protection Guides. Surveillance data from a number of Federal and State programs are published periodically to show current and long-range trends. Water sampling activities reported in *Radiation Data and Reports* are listed below.

Water sampling program	Period reported	Issue
California	January–December 1970	June 1972
Colorado River Basin	1968	March 1972
Community Water Supply Study	1969	September 1972
Florida	1969	January 1972
Interstate Carrier Drinking Water	1971	May 1972
Kansas	January–December 1971	February 1973
Minnesota	July 1970–June 1971	November 1972
North Carolina	1968–1970	September 1972
Radiostrontium in Tap Water, *HASL*	July–December 1971	November 1972
Tritium Surveillance	January–March 1973	July 1973
U.S. Surface Waters	January 1969–December 1970	July 1973

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[1] Absence is taken to mean a negligibly small fraction of the specific limits of 3 pCi/liter and 10 pCi/liter for unidentified alpha-particle emitters and strontium-90, respectively.

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(*4*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 2. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (September 1961).

Water Surveillance Programs
February 1973 and 1972 Special Analyses

National Environmental Research Center—Las Vegas, Environmental Protection Agency

The Water Surveillance Network,[1] operated by the National Environmental Research Center—Las Vegas (NERC-LV), consists of 61 sampling locations (figures 1 and 2) situated in the offsite area surrounding the Nevada Test Site (NTS). This routine network is operated in support of the nuclear testing programs sponsored by the U.S. Atomic Energy Commission (AEC) at the Nevada Test Site.

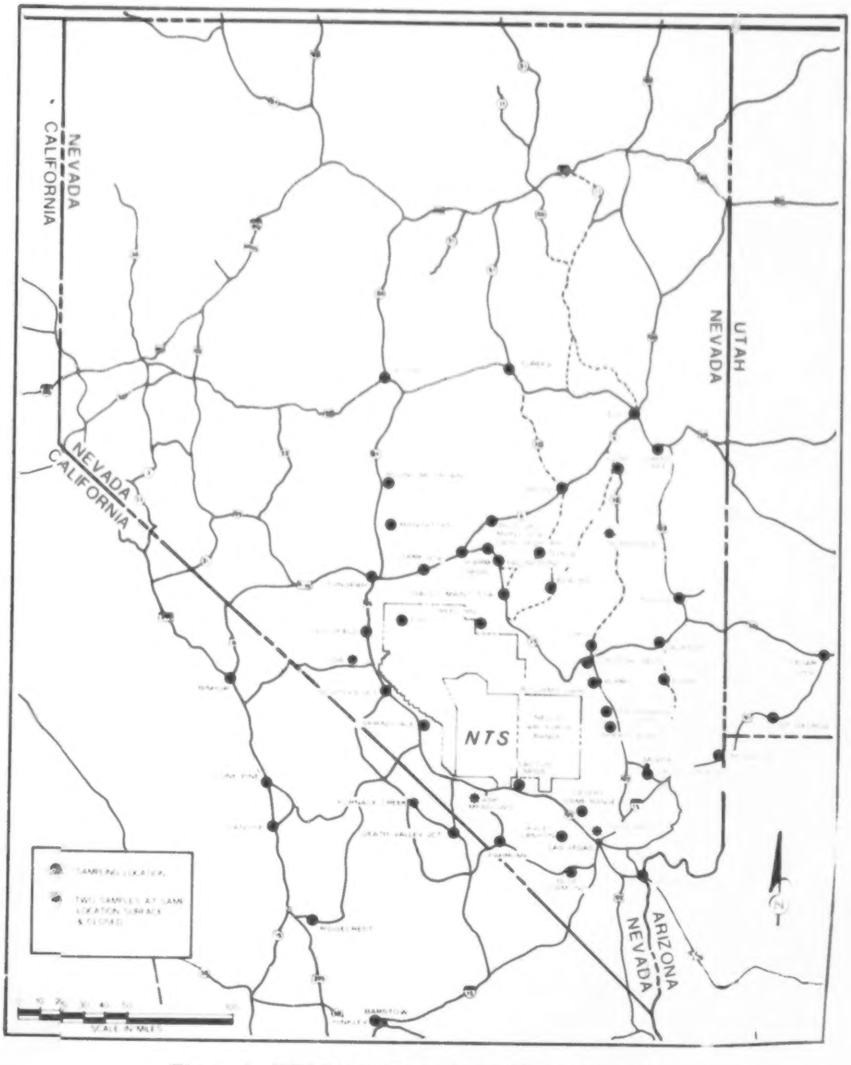
NEVADA
CALIFORNIA
UTAH
NEVADA
NEVADA
CALIFORNIA
NTS
ARIZONA
NEVADA
SAMPLING LOCATION
TWO SAMPLES AT SAME LOCATION SURFACE & GROUND
0 10 20 30 40 50 100
SCALE IN MILES
BARSTOW
N

Figure 1. NERC–LV Water Surveillance Network

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[1] This network is operated under a Memorandum of Understanding (No. AT (26–1)–539) with the Nevada Operations Office, U.S. AEC, Las Vegas, Nev.

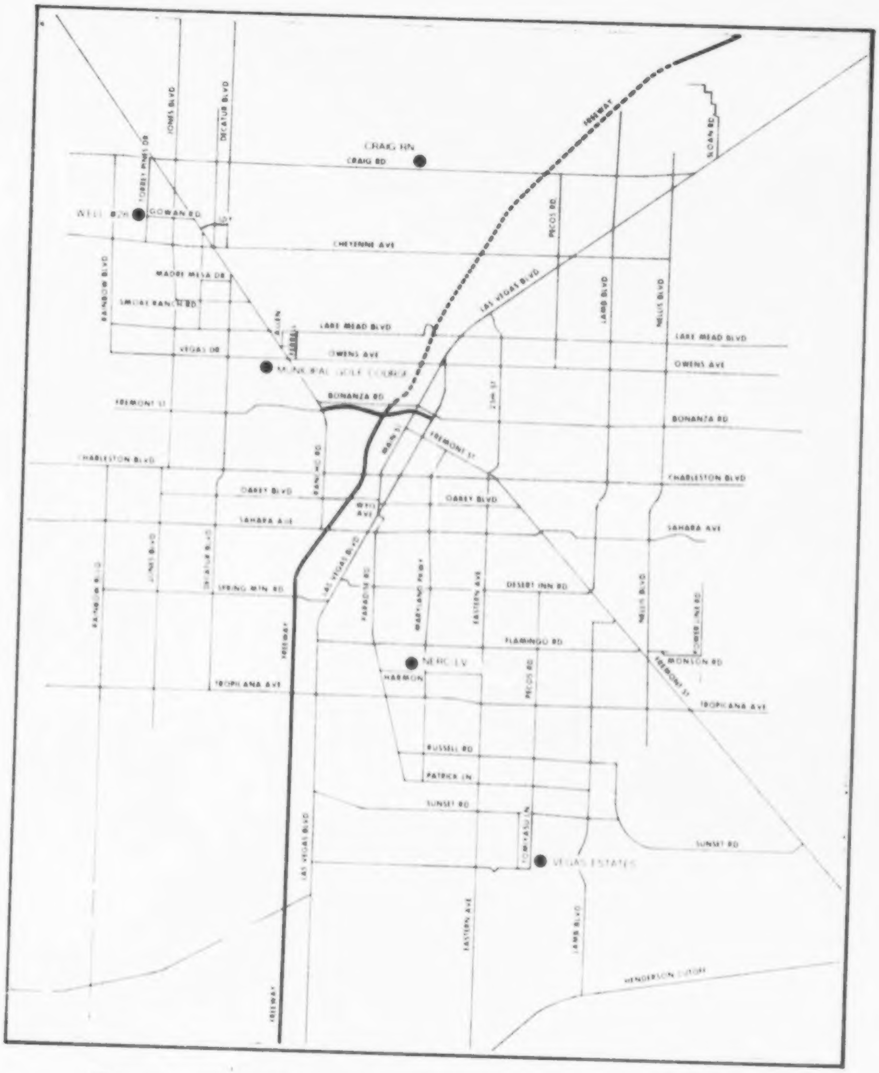
CRAIG RN
CRAIG RD
WELL #28
GOWAN RD
TORREY PINES DR
JONES BLVD
DECATUR BLVD
CHEYENNE AVE
MADRE MESA DR
SMOKE RANCH RD
RAINBOW BLVD
LAKE MEAD BLVD
VEGAS DR
OWENS AVE
ALLEN
MUNICIPAL GOLF COURSE
BONANZA RD
FREMONT ST
CHARLESTON BLVD
OAKEY BLVD
RANCHO RD
MAIN ST
WYLE AVE
SAHARA AVE
FREEWAY
LAS VEGAS BLVD
PECOS RD
LAMB BLVD
NELLIS BLVD
SLOAN RD
25TH ST
SPRING MTN RD
PARADISE RD
MARYLAND PKWY
EASTERN AVE
DESERT INN RD
FLAMINGO RD
NERC-LV
HARMON
MONSON RD
POWER LINE RD
TROPICANA AVE
RUSSELL RD
PATRICK LN
SUNSET RD
TOMIYASU LN
VEGAS ESTATES
HENDERSON CUTOFF

Figure 2. NERC-LV Water Surveillance Network—Las Vegas Valley

In the event of a release of radioactivity from the NTS, special sampling within the affected areas is conducted to determine radionuclide concentrations and to take protective action, if required. Additional water sampling networks are operated in support of AEC operations in areas other than the NTS when requested. A complete description of sampling and routine analytical procedures was included with the water results reported in the July 1973 issue of *Radiation Data and Reports.*

For the purpose of identifying the source of the gross radioactivity in all network samples and comparing sample concentrations with both the AEC concentration guides and the PHS Drinking Water Standards, selected samples from each sampling location are given special analyses at least once a year beginning with calendar year 1972. For surface water samples, the special analyses includes strontium-89, strontium-90, plutonium-238, plutonium-239, uranium, and radium-226. For drinking water samples, the analyses include strontium-89, strontium-90, uranium, and radium-226.

Results

The routine analytical results of all water samples collected in February by the NERC-LV Water Surveillance Network are listed in table 1. No gamma-emitting fission products were identified by gamma spectrometry in any of the samples collected. Table 2 presents results of special analyses performed on water samples collected during 1972. The analytical results of samples selected during the current year for special analyses will be reported at a later date.

Table 1. Water surveillance results, February 1973

Location	Date collected (1973)	Sample type [a]	Radioactivity concentrations [b] (pCi/liter)		
			Gross alpha	Gross beta	Tritium
California:					
Bishop:					
Fish and Game Office	2/1	23	<5.6	4.6 ± 3.5	NA
Death Valley Junction:					
Lila's Cafe	2/2	23	<1.6	<3.2	480 ± 240
Furnace Creek:					
Pond	2/2	21	<4.5	9.5 ± 3.8	NA
Visitor Center	2/2	27	<4.1	7.2 ± 3.6	NA
Hinkley:					
Bill Nelson Dairy	2/1	23	8.1 ± 5.7	4.5 ± 3.4	NA
Lone Pine:					
Forest Service Ranger Station	2/2	23	<2.0	<3.2	NA
Olancha:					
Haiwee Reservoir	2/1	21	6.3 ± 4.3	6.2 ± 3.5	NA
Ridgecrest:					
City Hall	2/1	23	<3.9	<3.3	NA
Nevada:					
Adaven:					
Canfield Ranch	NS				
Alamo:					
Pahranagat Lake	2/5	21	<4.4	12 ± 3.7	NA
Sheri's Bar	2/5	23	<3.1	3.9 ± 3.2	NA
Williams Dairy	2/5	23	<4.2	8.3 ± 3.7	NA
Ash Meadows:					
Ash Meadows Lodge	2/14	23	<4.4	12 ± 4.3	<250
Pond	2/14	21	7.1 ± 6.7	8.4 ± 4.2	NA
Austin:					
Nevada National Bank	2/5	27	33 ± 7.5	12 ± 3.8	NA
Blue Diamond:					
Post Office	2/9	23	5.3 ± 4.2	<3.5	<250
Blue Jay Highway Maintenance Station	2/7	23	<3.3	4.9 ± 3.2	NA
Cactus Springs:					
Mobil Service Station	2/14	27	2.9 ± 2.5	<3.5	<250
Caliente:					
Agricultural Extension Station	2/7	23	6.5 ± 4.2	<3.3	NA
Clark Station:					
Five Mile Ranch	2/6	27	<2.4	5.4 ± 3.3	NA
Currant:					
Currant Ranch Cafe	2/7	27	5.5 ± 4.3	3.3 ± 3.1	NA
Diablo:					
Highway Maintenance Station	2/6	23	<2.7	5.2 ± 3.3	NA
Reed Ranch	2/5	21	9.1 ± 6.4	26 ± 4.6	NA
Elgin:					
Water tower	2/7	23	11 ± 5.7	6.9 ± 3.6	NA
Ely:					
Chevron Service Station	2/6	24	<2.7	<3.1	NA
Comins Lake	NS				
Eureka:					
Highway Maintenance Station	2/1	24	3.6 ± 3.3	4.7 ± 3.4	NA
Goldfield:					
Chevron Service Station	2/5	23	<3.2	3.2 ± 3.1	NA
Hiko:					
Crystal Springs	2/5	27	6.5 ± 4.1	9.3 ± 3.7	NA
Schofield Dairy	2/5	23	21 ± 7.1	23 ± 4.4	NA
Las Vegas:					
Craig Ranch Golf Course	2/9	23	5.6 ± 3.6	5.3 ± 3.4	<250
Desert Game Range	2/9	23	5.4 ± 3.5	<3.4	<250
Lab II NERC	2/12	24	8.6 ± 5.8	6.3 ± 3.7	1,100 ± 270
Lake Mead Vegas Wash	2/12	21	<4.0	5.9 ± 3.7	1,300 ± 270
L V Water District Well 28	2/9	23	<2.8	<3.3	<250
Municipal Golf Course	2/9	23	4.0 ± 3.2	<3.3	<250
Tule Springs	2/9	23	3.3 ± 2.8	<3.4	<250
Tule Springs Pond	2/9	21	<2.7	<3.4	NA
Vegas Estates	2/9	23	<4.4	13 ± 4.0	<250
Lida:					
Lida Livestock Company	2/5	27	<3.2	<3.1	NA
Pond at storage tank	2/5	21	<2.8	<3.4	NA

See footnotes at end of table.

Table 1. Water surveillance results, February 1973—continued

Location	Date collected (1973)	Sample type [a]	Radioactivity concentrations [b] (pCi/liter)		
			Gross alpha	Gross beta	Tritium
Nevada: continued:					
Lund:					
Gardner Grocery	2/8	23	3.8 ± 3.2	4.3 ± 3.2	NA
Manhattan:					
Country store	2/6	23	13 ± 6.3	4.9 ± 3.6	NA
Mesquite:					
Hughes Bros. Dairy	2/5	23	<4.7	4.4 ± 3.4	NA
Moapa:					
Pedersen Valley View Ranch	2/5	27	8.8 ± 5.6	11 ± 3.8	NA
Mt. Charleston:					
Kyle Canyon Fire Station	2/9	27	<2.2	<3.4	<250
Nyala:					
Sharp's Ranch	2/8	23	<3.0	4.5 ± 3.2	NA
Pahrump:					
Texaco Service Station	2/20	23	<2.5	<3.5	NA
Pioche:					
County courthouse	2/6	24	3.3 ± 3.1	<3.3	NA
Round Mountain:					
Mobil Service Station	2/6	27	2.7 ± 2.5	<3.4	NA
Scotty's Junction:					
Chevron Service Station	2/5	23	15 ± 7.7	12 ± 3.8	<250
Springdale:					
Pond	2/13	21	<4.5	6.3 ± 3.8	NA
Sunnyside:					
Adam McGill Reservoir	NS				
Wildlife Management Headquarters	2/8	27	<2.3	<3.1	NA
Tonopah:					
Jerry's Chevron Station	2/7	23	<3.5	7.4 ± 3.7	NA
Tonopah Test Range CP-1	2/7	23	<3.9	7.4 ± 3.4	NA
Warm Springs:					
Fallini's Pond	2/7	21	7.0 ± 5.5	19 ± 4.1	NA
Service station and cafe	2/5	27	13 ± 7.7	19 ± 4.5	NA
Twin Springs Ranch	2/7	23	9.5 ± 5.5	12 ± 4.0	NA
Utah:					
Cedar City:					
M. D. Baldwin residence	2/6	24	3.5 ± 3.3	6.0 ± 3.4	NA
St. George:					
R. Cox Dairy	2/5	21	2.6 ± 2.2	<3.2	NA

[a] 21—Pond, lake, reservoir, stock tank, stock pond.
22—Stream, river, creek.
23—Well.
24—Multiple supply—Mixed (A water sample consisting of mixed or multiple sources of water, such as well and spring.)
27—Spring.

[b] Two-sigma counting error provided when available.

NA, no analysis.

NS, no sample.

Table 2. Special analytical results for water samples collected during 1972

Location	Date collected (1972)	Sample type [a]	Radionuclide concentrations [b] (pCi/liter)							
			^{89}Sr	^{90}Sr	^{226}Ra	^{238}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U
California:										
Bishop:										
Fish & Game Office	4/5	23	<4	<1	0.1 ±0.08	NA	NA	0.3 ±0.05	<0.008	0.2 ±0.04
	5/9	23	<3	<0.9	.2 ± .1	NA	NA	NA	NA	NA
Owens River, 3 miles E	4/5	22	NA	NA	NA	<0.02	0.01 ±0.01	NA	NA	NA
Death Valley Junction:										
Lila's Cafe	4/6	23	<4	<1	.1 ± .1	NA	NA	1.6 ± .1	.059 ± .022	1.5 ± .1
Furnace Creek:										
Pond	4/6	21	NA	NA	NA	<.02	.02 ± .02	NA	NA	NA
	5/10	21	NA	NA	.1 ± .08	NA	NA	NA	NA	NA
Visitor Center	4/6	27	<4	<1	.3 ± .1	NA	NA	1.0 ± .08	.044 ± .016	1.0 ± .07
Hinkley:										
Bill Nelson Dairy	4/3	23	<4	<1	.4 ± .2	NA	NA	5.1 ± .2	.18 ± .03	4.8 ± .2
	7/3	23	NA	NA	.5 ± .2	NA	NA	NA	NA	NA
	8/1	23	NA	NA	.4 ± .2	NA	NA	NA	NA	NA
Little Lake:										
Little Lake Ranch	4/4	21	NA	NA	NA	<.02	.01 ± .01	NA	NA	NA
Lone Pine:										
Diaz Lake	4/4	21	NA	NA	NA	<.03	.02 ± .01	NA	NA	NA
	5/8	21	NA	NA	.6 ± .4	NA	NA	12 ± .5	.45 ± .09	12 ± .4
	7/5	21	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
Forest Service Ranger Station	4/5	23	<4	<1	.3 ± .1	NA	NA	.44 ± .05	.012 ± .008	.43 ± .05
	5/8	23	<3	<1	.1 ± .1	NA	NA	NA	NA	NA
Olancha:										
Haiwee Reservoir	4/4	21	NA	NA	NA	<.02	<.01	NA	NA	NA
Ridgecrest:										
City Hall	4/4	23	<5	<1	.5 ± .2	NA	NA	.4 ± .05	.012 ± .009	.4 ± .05
	5/8	23	<3	<3	.1 ± .1	NA	NA	2.6 ± .2	.09 ± .04	2.5 ± .5
Shoshone:										
Chevron Service Station	4/6	27	<4	<1	.2 ± .1	NA	NA	NA	NA	NA
Nevada:										
Alamo:										
Pahranagat Lake	2/8	21	<5	<1	.5 ± .2	<.02	<.01	6.8 ± .2	.3 ± .04	6.4 ± .2
	4/4	21	NA	NA	NA	<.03	.03 ± .02	NA	NA	NA
	7/5	21	<1	<.1	NA	NA	NA	NA	NA	NA
	8/1	21	<3	<1	NA	NA	NA	NA	NA	NA
	9/5	21	<2	1 ±1	.3 ± .1	NA	NA	NA	NA	NA
	10/2	21	<3	<1	NA	NA	NA	NA	NA	NA
	12/1	21	NA	NA	.48 ± .16	NA	NA	NA	NA	NA
Williams Dairy	2/8	23	<4	<1	.3 ± .1	<.02	<.01	1.7 ± .1	.09 ± .03	1.6 ± .1
	4/4	23	<4	<1	.1 ± .1	NA	NA	1.7 ± .1	.078 ± .026	1.6 ± .1
	5/5	23	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
Ash Medows:										
Ash Medows Lodge	2/9	23	<4	<1	.7 ± .2	<.02	<.01	1.6 ± .2	.06 ± .04	1.6 ± .2
	4/10	23	<5	<1	.3 ± .1	NA	NA	.8 ± .08	.028 ± .014	.8 ± .06
	5/3	23	NA	NA	.6 ± .2	NA	NA	NA	NA	NA
	8/2	23	NA	NA	.6 ± .2	NA	NA	NA	NA	NA
	11/1	23	NA	NA	.6 ± .2	NA	NA	NA	NA	NA
Pond	2/9	21	<4	<1	.3 ± .1	<.02	<.01	7.9 ± .4	.2 ± .1	7.5 ± .4
	4/10	21	NA	NA	.2 ± .1	<.02	.02 ± .02	6.4 ± .2	.21 ± .04	6.1 ± .2
	5/3	21	<3	<1	.6 ± .2	NA	NA	NA	NA	NA
	6/1	21	NA	NA	.1 ± .1	NA	NA	4.2 ± .2	.17 ± .04	3.9 ± .2
Austin:										
County courthouse	2/9	27	<4	<1	.1 ± .1	<.02	<.01	13.8 ± .6	.5 ± .1	13.0 ± .6
	4/5	27	<4	<1	<.6	NA	NA	13.0 ± .28	.37 ± .048	12.0 ± .27
	5/4	27	NA	NA	.5 ± .2	NA	NA	NA	NA	NA
	6/2	27	NA	NA	.2 ± .1	NA	NA	NA	NA	NA

See footnotes at end of table.

Table 2. Special analytical results for water samples collected during 1972—continued

Location	Date collected (1972)	Sample type [a]	Radionuclide concentrations [b] (pCi/liter)							
			^{89}Sr	^{90}Sr	^{226}Ra	^{238}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U
Nevada: continued:										
Austin:										
County courthouse	7/13	27	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
	9/7	27	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
	10/4	27	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
	12/1	27	NA	NA	.33 ± .14	NA	NA	NA	NA	NA
Beatty:										
Richfield Service Station	2/10	23	<4	<1	.2 ± .1	<.03	<.02	2.8 ± .3	.09 ± .05	2.8 ± .3
	4/6	23	<4	<1	.3 ± .1	NA	NA	2.2 ± .1	.069 ± .024	2.1 ± .1
	5/2	23	NA	NA	.1 ± .1	NA	NA	NA	NA	NA
	10/5	23	NA	NA	.4 ± .1	NA	NA	NA	NA	NA
	11/1	23	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
Blue Diamond:										
Post Office	4/10	23	<3	<.8	2.7 ± .5	NA	NA	NA	NA	NA
	9/6	23	NA	NA	1.2 ± .3	NA	NA	NA	NA	NA
Blue Jay Highway Maintenance Station	4/5	23	<3	<1	<.6	NA	NA	1.3 ± .09	.036 ± .017	1.2 ± .08
Cactus Springs:										
Mobile Service Station	4/7	27	<4	<1	.2 ± .1	NA	NA	.53 ± .07	.017 ± .013	.5 ± .06
Caliente:										
Agricultural Extension Station	4/4	23	<4	<1	.1 ± .1	NA	NA	1.8 ± .1	.006 ± .002	1.7 ± .1
	5/3	23	NA	NA	.1 ± .09	NA	NA	NA	NA	NA
Meadow Valley wash	4/4	22	NA	NA	NA	<.02	<.01	NA	NA	NA
Clark Station:										
Five Mile Ranch	2/10	27	<5	<1	0.6 ±0.2	<0.04	<0.02	0.3 ±0.1	0.02 ±0.01	0.2 ±0.1
	4/5	27	<3	<1	<.3	NA	NA	.2 ± .04	.015 ± .01	.2 ± .03
Coyote Summit:										
Sand Spring Well	4/5	23	NA	NA	<.6	<.02	.01 ± .01	14.0 ± .28	.48 ± .05	13.0 ± .27
	10/3	23	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
Currant:										
Currant Pond	4/6	21	NA	NA	NA	<.02	<.01	NA	NA	NA
Currant Ranch Cafe	4/6	27	<4	<1	.5 ± .2	NA	NA	2.5 ± .1	.081 ± .026	2.4 ± .1
	7/12	27	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
	10/4	27	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
Diablo:										
Highway Maintenance Station	4/5	23	<5	<1	<.6	NA	NA	.72 ± .066	.035 ± .015	.67 ± .064
Reed Ranch	2/8	21	<4	<1	.2 ± .1	<.04	<.02	3.0 ± .3	.2 ± .1	2.8 ± .3
	4/5	21	NA	NA	NA	<.03	.02 ± .02	NA	NA	NA
	6/2	21	<3	3 ±1	.2 ± .1	NA	NA	NA	NA	NA
	8/1	21	<3	<1	NA	NA	NA	NA	NA	NA
	9/6	21	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
	10/3	21	<3	1 ±1	NA	NA	NA	NA	NA	NA
Elgin:										
Water tower	4/5	23	<4	<1	.4 ± .1	NA	NA	2.4 ± .1	.098 ± .023	2.3 ± .1
	5/4	23	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
	7/6	23	<2	<.8	.2 ± .1	NA	NA	NA	NA	NA
Ely:										
Chevron Service Station	4/4	24	<3	<.9	.5 ± .2	NA	NA	.57 ± .06	.021 ± .011	.54 ± .06
Comins Lake	4/4	21	<4	<1	.3 ± .1	<.02	.01 ± .01	3.0 ± .1	.14 ± .03	2.8 ± .1
	5/3	21	<4	2 ±1	NA	NA	NA	NA	NA	NA
	6/1	21	3 ±3	<1	NA	NA	NA	NA	NA	NA
	7/14	21	<2	2 ±1	NA	NA	NA	4.5 ± .2	.17 ± .04	4.2 ± .2
	8/1	21	<3	<1	NA	NA	NA	NA	NA	NA
	10/2	21	<3	<1	NA	NA	NA	NA	NA	NA
Eureka:										
Chevron Service Station	4/6	24	<4	<1	.1 ± .08	NA	NA	.62 ± .07	.024 ± .014	.59 ± .07
Glendale:										
Chevron Service Station	4/4	27	<4	<.9	.6 ± .2	NA	NA	1.3 ± .1	.054 ± .029	1.2 ± .1
Muddy River	6/1	22	<2	<1	NA	NA	NA	NA	NA	NA
	7/5	22	<2	<.7	NA	NA	NA	NA	NA	NA

See footnotes at end of table.

Table 2. Special analytical results for water supplies collected during 1972—continued

Location	Date collected (1972)	Sample type [a]	Radionuclide concentrations [b] (pCi/liter)							
			^{89}Sr	^{90}Sr	^{226}Ra	^{238}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U
Nevada: continued:										
Goldfield:										
Alkali Springs	2/8	21	<4	<1	.5 ± .2	<.03	<.009	.03 ± .02	.01 ± .01	.02 ± .01
	4/3	21	<4	<1	<.6	<.03	.03 ± .02	.045 ± .017	<.005	.041 ± .015
	5/3	21	<3	<1	NA	NA	NA	NA	NA	NA
	6/1	21	3 ±2	<1	NA	NA	NA	NA	NA	NA
	8/1	21	<2	<1	NA	NA	NA	NA	NA	NA
Chevron Service Station	4/3	23	<4	<1	.3 ± .1	NA	NA	.12 ± .028	<.005	.11 ± .025
Hawthorne:										
Walker Lake	2/15	21	<2	<2	.4 ± .01	NA	NA	36.2 ±1.4	1.1 ± .2	33.0 ±1.3
	6/1	21	<3	<1	NA	NA	NA	NA	NA	NA
	9/8	21	<2	2 ±1	.2 ± .1	NA	NA	NA	NA	NA
Hiko:										
Crystal Springs	2/8	27	<4	<1	.8 ± .2	<.02	<.01	1.3 ± .1	.08 ± .02	1.2 ± .1
	4/4	27	<4	<1	.8 ± .2	NA	NA	1.4 ± .1	.038 ± .017	1.4 ± .1
Schofield Dairy	2/8	23	<4	<1	0.7 ±0.2	<0.02	<0.01	9.6 ±0.3	0.36 ±0.05	9.1 ±0.3
	4/4	23	<4	<1	.2 ± .1	NA	NA	9.5 ± .4	.33 ± .08	9.0 ± .4
	5/2	23	<3	<0.9	.2 ± .1	NA	NA	NA	NA	NA
	6/2	23	<3	<1	NA	NA	NA	NA	NA	NA
	7/5	23	<3	<1	.2 ± .1	NA	NA	NA	NA	NA
	8/1	23	NA	NA	.6 ± .2	NA	NA	NA	NA	NA
	10/2	23	<2	<3	.6 ± .2	NA	NA	NA	NA	NA
	12/1	23	<2	<1	NA	NA	NA	NA	NA	NA
Indian Springs:										
Chevron Service Station	2/8	23	<4	<1	.3 ± .1	<.03	<.02	.6 ± .1	.03 ± .03	.5 ± .1
	4/6	23	<4	<1	.4 ± .2	NA	NA	.64 ± .07	.028 ± .014	.6 ± .07
	5/5	23	NA	NA	.1 ± .1	NA	NA	NA	NA	NA
Las Vegas:										
Cal-Nev Jet Fuels	4/10	23	<4	<1	.7 ± .2	NA	NA	NA	NA	NA
Craig Ranch Golf Course	4/10	23	<4	<1	1.6 ± .5	NA	NA	1.0 ± .08	.034 ± .014	1.0 ± .07
Cunningham Ranch	4/10	23	<4	<1	.3 ± .1	NA	NA	.59 ± .07	.027 ± .017	56 ± .07
Desert Game Range	2/8	23	<4	<1	.3 ± .1	<.02	<.02	1.3 ± .2	<.5	1.2 ± .2
	4/7	23	<4	<1	.2 ± .1	NA	NA	.87 ± .07	.046 ± .015	.81 ± .07
Desert Game Range Pond	4/7	21	NA	NA	NA	<.02	.02 ± .02	NA	NA	NA
Francis residence	4/10	23	<4	<1	.3 ± .1	NA	NA	1.6 ± .1	.076 ± .021	1.4 ± .1
	5/8	23	<3	<1	NA	NA	NA	NA	NA	NA
Lab II NERC	4/10	24	<5	<2	.2 ± .1	NA	NA	1.9 ± .1	.059 ± .018	1.8 ± .1
Lake Mead Vegas Wash	4/10	21	NA	NA	NA	<.02	.01 ± .01	NA	NA	NA
L V Water District Well 28	4/10	23	<4	<1	.2 ± .1	NA	NA	.29 ± .05	.013 ± .011	.28 ± .04
LDS Dairy Farms	4/11	23	<4	<1	.2 ± .1	NA	NA	1.8 ± .1	.066 ± .022	1.7 ± .1
	5/9	23	NA	NA	.1 ± .1	NA	NA	NA	NA	NA
	6/1	23	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
Lloyd Ranch	4/10	23	<4	<1	.2 ± .1	NA	NA	1.6 ± .1	.057 ± .017	1.5 ± .1
Municipal Golf Course	4/10	23	<4	<1	.3 ± .1	NA	NA	.65 ± .07	.023 ± .013	.62 ± .07
	7/10	23	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
Tule Springs	4/7	23	<4	<1	.4 ± .2	NA	NA	.67 ± .07	.031 ± .015	.62 ± .07
	9/5	23	NA	NA	<.1	NA	NA	NA	NA	NA
Vegas Estates	4/10	23	<4	<.9	.2 ± .1	NA	NA	.47 ± .06	.02 ± .013	.44 ± .06
Lathrop Wells:										
Texaco Service Station	4/6	23	<4	<1	.1 ± .1	NA	NA	.36 ± .06	.011 ± .009	.34 ± .06
	6/1	23	<2	<1	NA	NA	NA	NA	NA	NA

See footnotes at end of table.

Table 2. Special analytical results for water samples collected during 1972—continued

Location	Date collected (1972)	Sample type [a]	Radionuclide concentrations [b] (pCi/liter)							
			^{89}Sr	^{90}Sr	^{226}Ra	^{238}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U
Nevada: continued										
Lida:										
Lida Livestock Company	4/3	27	<4	<1	.1 ± .08	NA	NA	.64 ± .07	.017 ± .013	.61 ± .07
Pond at storage tank	4/3	21	NA	NA	NA	<.02	.01 ± .01	NA	NA	NA
Lida Junction:										
Cottontail Ranch	4/3	23	<4	<1	<.4	NA	NA	1.3 ± .09	.058 ± .019	1.2 ± .09
	5/5	23	NA	NA	.1 ± .09	NA	NA	NA	NA	NA
	6/1	23	<2	<1	NA	NA	NA	NA	NA	NA
	9/5	23	NA	NA	.4 ± .2	NA	NA	NA	NA	NA
Lund:										
Gardner Grocery	4/5	23	<4	<1	.2 ± .1	NA	NA	1.1 ± .1	.032 ± .015	1.1 ± .1
Manhattan:										
Country store	4/5	23	<3	<1	<0.6	NA	NA	4.0 ±0.15	0.26 ±0.04	3.8 ±0.15
	5/4	23	NA	NA	.4 ± .1	NA	NA	NA	NA	NA
	6/2	23	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
	7/11	23	NA	NA	.7 ± .2	NA	NA	NA	NA	NA
	8/2	23	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
	9/6	23	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
	10/4	23	NA	NA	.4 ± .2	NA	NA	NA	NA	NA
	11/2	23	NA	NA	.2 ± .1	NA	NA	NA	NA	NA
	12/1	23	NA	NA	.2 ± .12	NA	NA	NA	NA	NA
Seyler Reservoir	4/5	21	<4	<1	NA	<.02	.02 ± .01	NA	NA	NA
	9/6	21	<2	<1	.3 ± .1	NA	NA	NA	NA	NA
Mercury:										
Groom Lake	4/4	23	<3	<1	<.6	NA	NA	NA	NA	NA
Moapa:										
Pedersen Valley View Ranch	4/4	27	<4	<1	1.0 ± .2	NA	NA	1.3 ± .1	.053 ± .023	1.2 ± .1
	6/2	27	<3	<.9	NA	NA	NA	NA	NA	NA
Mt. Charleston:										
Kyle Canyon Pond	4/7	21	NA	NA	NA	<.03	<.01	NA	NA	NA
Nyala:										
Sharp's Ranch	4/5	23	<5	<2	<.6	NA	NA	.72 ± .068	.02 ± .012	.68 ± .068
Pahrump:										
Texaco Service Station	4/10	23	<5	<1	.2 ± .1	NA	NA	.7 ± .078	.035 ± .017	NA
Pioche:										
County courthouse	4/5	24	<4	<1	.1 ± .09	NA	NA	.7 ± .077	.026 ± .015	.66 ± .075
	7/6	24	<2	<.8	NA	NA	NA	NA	NA	NA
	8/2	24	NA	NA	.5 ± .2	NA	NA	NA	NA	NA
Round Mountain:										
Mobil Service Station	4/5	27	<4	<1	.2 ± .1	NA	NA	.74 ± .08	.029 ± .017	.7 ± .08
Scotty's Jct:										
Chevron Service Station	4/3	23	<4	<1	.3 ± .1	NA	NA	1.9 ± .1	.081 ± .025	1.8 ± .1
Springdale:										
Peacock Ranch	4/12	27	<3	<.9	.2 ± .1	NA	NA	1.0 ± .1	.03 ± .016	.9 ± .1
	6/2	27	<2	<1	NA	NA	NA	NA	NA	NA
Pond	4/12	21	NA	NA	NA	<.02	<.01	NA	NA	NA
Sunnyside:										
Wildlife Management Headquarters	4/5	27	<4	<1	.1 ± .08	NA	NA	.48 ± .06	.02 ± .012	.45 ± .06
Tonopah:										
Tonopah Test Range CP-1	4/4	23	<4	<1	.1 ± .1	NA	NA	1.7 ± .1	.056 ± .022	1.6 ± .1
Warm Springs:										
Fellini's Pond	4/5	21	<4	<1	.6 ± .6	<.03	.09 ± .03	5.0 ± .2	.14 ± .03	4.8 ± .2
	5/3	21	<3	<1	NA	NA	NA	NA	NA	NA
	6/1	21	3 ±2	<1	NA	NA	NA	NA	NA	NA
	7/6	21	2 ±2	<.8	1.2 ± .2	NA	NA	NA	NA	NA
	8/2	21	<4	2 ±2	1.3 ± .2	NA	NA	2.6 ± .32	.19 ± .09	2.4 ± .3
	10/4	21	NA	NA	1.3 ± .2	NA	NA	NA	NA	NA
	11/4	21	<2	4.3 ±1.2	NA	NA	NA	NA	NA	NA
	12/6	21	<2	<1.1	NA	NA	NA	NA	NA	NA
Hot Creek Ranch	4/5	27	<3	<1	<.4	NA	NA	NA	NA	NA
	10/4	27	<2	<1	NA	NA	NA	NA	NA	NA

See footnotes at end of table.

Location	Date collected (1972)	Sample type [a]	Radionuclide concentrations [b] (pCi/liter)							
			^{90}Sr	^{89}Sr	^{226}Ra	^{238}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U
Nevada: continued										
Warm Springs:										
Service station and cafe	4/5	27	<3	<1	6.9 ±2.4	NA	NA	.28 ± .042	.014 ± .009	.26 ± .041
	6/1	27	<2	<1	9.7 ± .7	NA	NA	NA	NA	NA
	7/5	27	NA	NA	8.0 ± .6	NA	NA	NA	NA	NA
	8/2	27	NA	NA	10 ±0.6	NA	NA	NA	NA	NA
	10/3	27	<2	<1	11 ± .7	NA	NA	NA	NA	NA
	11/13	27	<2	<2	11 ± .8	NA	NA	NA	NA	NA
Twin Springs Ranch	4/5	23	<3	<1	<.2	NA	NA	1.4 ± .086	.055 ± .017	1.3 ±.083
	7/6	23	NA	NA	.4 ± .2	NA	NA	NA	NA	NA
	9/7	23	NA	NA	<.1	NA	NA	NA	NA	NA
Utah:										
Cedar City:										
M. D. Baldwin Residence	4/5	24	<4	<1	.2 ± .1	NA	NA	.4 ± .05	.017 ± .01	.4 ± .05
	8/1	24	NA	NA	.3 ± .1	NA	NA	NA	NA	NA
	9/6	24	NA	NA	<.1	NA	NA	NA	NA	NA
Garrison:										
Rowley Grocery	4/4	23	<4	<1	.2 ± .1	NA	NA	1.3 ± .1	.054 ± .02	1.3 ± .1
Newcastle:										
Newcastle Dairy	4/6	24	<4	<1	.4 ± .1	NA	NA	1.2 ± .08	.05 ± .02	1.1 ± .08
Municipal Reservoir	4/5	21	NA	NA	NA	<.02	.02 ± .02	NA	NA	NA
St. George:										
R. Cox Dairy	4/5	24	<3	<.8	.2 ± .1	NA	NA	.98 ± .09	.036 ± .016	.92 ± .09
	7/5	24	NA	NA	.4 ± .2	NA	NA	NA	NA	NA

[a] 21—Pond, lake, reservoir, stock tank, stock pond.
22—Stream, river, creek.
23—Well.
24—Multiple supply—mixed (A water sample consisting of mixed or multiple sources of water, such as well and spring.)
27—Spring.

[b] Two-sigma counting error provided when available.
NA, no analysis.

Radioactivity in New York State Surface Water July–December 1971

Bureau of Radiological Pollution Control
N.Y.S. Department of Environmental Conservation

In 1955 the New York State Department of Health began a program to determine the amount of radioactivity in water used for public consumption. Radioactivity in water may arise from any one or a combination of the following sources: the natural mineral content of water (background), atmospheric fallout, or nuclear industry operations.

Analytical procedures

Analysis of samples was performed by the Radiological Sciences Laboratory of the New York State Department of Health. The procedures described below were used to perform the indicated analyses.

A gross beta determination is made on a measured quantity of water, usually 250 ml. The sample residue is analyzed for its gross beta component in an end window, gas flow proportional counter.

Strontium and alkaline earths are precipitated as carbonates from a 500 ml sample. Iron and rare earths are removed by hydroxide scavenging, while barium is precipitated as a chromate. Strontium is finally precipitated as a sulfate from a pH controlled EDTA solution. Calcium and yttrium remain in solution as EDTA complexes (*1–2*). Strontium-90 is determined by yttrium-90 counting of the final precipitate at less than 6 hours after precipitation and again at greater than 50 hours using a flow proportional counter. Strontium-89 is estimated by taking the difference between the total radiostrontium and the strontium-90 radioactivity. Chemical recovery is between 70 and 75 percent and results in a minimum detectable radioactivity of 3 pCi/liter ± 100 percent at the 95 percent confidence level.

Tritium in water is determined by liquid scintillation counting. The sample is vacuum distilled and an aliquot mixed with a scintillation cocktail (either 15 ml of Aquasol and 6 ml of distillate or 17 ml of a dioxane-base cocktail and 3 ml of distillate). Samples are counted for 50 minutes in either a Packard Tri-Carb model 3315 or Beckman LS200B liquid scintillation spectrometer. Minimum sensitivities are 1,000 pCi/liter for the Tri-Carb and 500 pCi/liter for the Beckman.

Discussion and results

The concentrations of radionuclides in most water samples throughout the State were low with exception of the water immediately downstream of the Nuclear Fuel Services fuel reprocessing plant (NFS) discharge (figure 1).

Three daily samples from Cattaraugus Creek at Springville Dam, Site 042 exceeded 600 pCi/liter of gross beta radioactivity which is considered to be the allowable AEC limit for a single sample without making a specific isotopic analysis.

Specific isotopic analyses were made on each of the three samples collected on October 7, 8, and November 4, 1971 and the concentration of the major isotopes present were determined (table 1).

The number of samples, quarterly average, maximum and minimum gross beta-particle concentrations in New York surface water for July–December 1971 are given in table 2.

Tritium concentration values for July–December 1971 are given in table 3. Tritium, the radioactive isotope of hydrogen, a very low beta-particle emitter, is released to the water courses during the reprocessing of nuclear fuel. The tritium concentrations in Cattaraugus and Buttermilk Creeks reflected contributions to the streams from the Nuclear Fuel Services reprocessing plant.

Recent coverage in *Radiation Data and Reports:*

Period	Issue
July–December 1970 and January–June 1971	May 1972

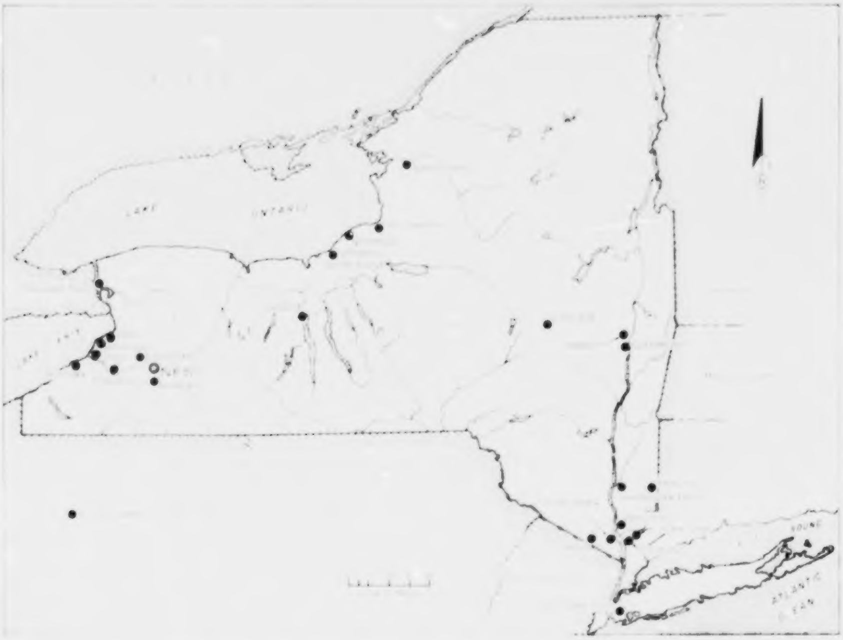

Figure 1. New York water sampling locations

Table 1. Radioactivity in Cattaraugus Creek at Springville Dam, Site 042, 1971

Radionuclide	October 6-7, 1971		October 7-8, 1971		November 3-4, 1971		
	Concentration (pCi/liter)	Percent of AEC standards	Concentration (pCi/liter)	Percent of AEC standards	Concentration (pCi/liter)	Percent of AEC standards	AEC standard (pCi/liter)
Gross beta	1,023		795		1,175		
Strontium-90	68	22.6	117	39.0	100	33.32	300
Ruthenium-106	799	7.98	545	5.46	862	6.62	10,000
Cesium-137	ND	.0	18	.10	74	.38	20,000
Cobalt-60	ND	.0	ND	.0	9	.0	50,000
Cesium-134	ND	.0	ND	.0	29	.32	9,000
Antimony-125	55	.0	39	.0	120	.02	1,000,000
Tritium	100,940	3.36	51,670	1.72	41,410	1.38	3,000,000

ND, nondetectable.

REFERENCES

(*1*) PORTER, C., D. CAHILL, R. SCHNEIDER, P. ROBBINS, W. PERRY and B. KAHN. Anal Chem 33:1356 (1961).

(*2*) WELFORD, G. and D. SUTTON. A paper presented at the American Chemical Society meeting in New York City, September 1960.

Table 2. Gross beta radioactivity in New York raw surface water,[a] July-December 1971

Location	Gross beta radioactivity (pCi/liter)							
	July-September 1971				October-December 1971			
	Number of samples	Average	Maximum	Minimum	Number of samples	Average	Maximum	Minimum
Albany	3	1	3	ND	3	2	2	2
Angola (Angola Water Treatment Plant)	13	6	20	4	12	6	8	4
Ashford (Buttermilk Creek at Fox Valley Road)	3	4	5	3	3	4	8	ND
(Buttermilk Creek at Thomas Corners)[b]	13	5,167	8,665	2,226	13	3,299	12,294	179
(Cattaraugus Creek at Bigelow Bridge)	3	4	6	3	3	3	4	ND
Brant (Cattaraugus Creek at Irving)	13	115	196	72	14	106	288	41
Collins (Cattaraugus Creek at Gowanda)	4	86	138	48	NS			
Colonie (Filtration Plant)	13	4	5	3	13	3	5	3
Concord (Cattaraugus Creek at Springville Dam):								
Weekly composite sample	13	269	515	118	13	304	541	122
Daily continuous sample	64	262	573	91	59	299	1,175	35
Derby (Sturgeon Point)	13	6	17	4	11	5	7	3
Dunkirk (Dunkirk Filtration Plant)	14	4	15	2	11	3	4	2
Geneva (Seneca Lake)	3	6	7	5	3	4	5	3
Glenmont (Hudson River)	12	4	5	2	11	3	5	2
Haverstraw (Iona Filtration Gallery)	2	18	26	11	1	3		
New Haven (Demster Beach Road)	1	3			3	4	5	3
New York City	5	2	3	ND	3	3	4	2
Niagara Falls (West Branch Niagara River)	2	7	10	3	2	5	5	4
Ontario Filter Plant	13	4	6	3	12	4	5	4
Ossining (Hudson River at Sing Sing)	13	37	65	ND	11	18	63	ND
(Indian Brook Reservoir—raw)	3	7	11	ND	4	5	6	4
(Indian Brook Reservoir—treated)	3	2	4	ND	4	4	7	ND
Oswego	6	4	5	3	6	4	5	3
Pawling (Pond at United Nuclear)	4	4	7	3	3	2	2	2
Peekskill (Camp Field Filter Plant—raw)	3	14	38	ND	4	5	11	3
(Camp Field Filter Plant—treated)	3	2	4	ND	4	2	5	ND
(Hudson River at Standard Brands)	13	26	183	ND	11	15	35	ND
Rhinecliff (Hudson River)	7	4	6	3	8	3	4	2
Tuxedo (Indian Kill)	2	6	12	ND	NS			
(Indian Kill, 150 feet below reservoir)	3	5	12	ND	4	4	4	4
Wappinger (Hudson River)	6	3	4	ND	8	4	8	2
Watertown (Black River)	3	2	4	ND	3	3	5	2
Yorktown (Croton Reservoir)	3	12	28	4	4	4	5	2
(Croton Reservoir—deep well)	3	3	4	3	4	4	6	2

[a] Excluding tritium all strontium-90 concentrations were below detectable levels except during July-September at Peekskill (Hudson River at Standard Brands), 13 samples collected; maximum—3 pCi/liter, and ND for minimum and average; Ossining (Hudson River at Sing Sing), 12 samples collected; maximum—4 pCi/liter and ND for the minimum and average. October-December at Ossining (Hudson River at Sing Sing), 11 samples with a maximum of 4 pCi/liter and ND for minimum and average; Peekskill (Hudson River at Standard Brands), 11 samples with a maximum of 6 pCi/liter and ND for minimum and average.

[b] This station is on the Nuclear Fuels Services reprocessing plant site. ND, nondetectable. NS, no sample.

Table 3. Tritium concentration of New York surface waters, July-December 1971

Location	Tritium concentration (nCi/liter)							
	July-September 1971				October-December 1971			
	Number of samples	Average	Maximum	Minimum	Number of samples	Average	Maximum	Minimum
Albany	3	ND	ND	ND	3	ND	ND	ND
Angola (Water Treatment Plant)	5	ND	1.0	ND	4	ND	ND	ND
Ashford (Buttermilk Creek at Fox Valley Road)	3	ND	2.7	ND	3	ND	ND	ND
(Buttermilk Creek at Thomas Corners Road)[a]	13	1,060	1,480	450	13	329	774	7.5
(Cattaraugus Creek at Bigelow Bridge)	3	ND	ND	ND	3	ND	ND	ND
Brant (Cattaraugus Creek at Irving)	13	47.4	95.3	23.0	14	19.6	67.0	ND
Collins (Cattaraugus Creek at Gowanda)	13	42.0	69.1	27.6	NS			
Colonie (Filtration Plant)	7	ND	ND	ND	4	ND	ND	ND
Concord (Springville Power Dam on Cattaraugus Creek):			[b]					
Weekly composite sample	13	65.4	161	36.4	13	38.8	98.0	5.0
Daily continuous sample	64	64.6	181	20.7	59	41.2	184	ND
Derby (Sturgeon Plant)	5	ND	ND	ND	NS			
Dunkirk (Filtration Plant)	7	ND	ND	ND	2	ND	ND	ND
Geneva (Seneca Lake)	3	ND	ND	ND	3	ND	1.2	ND
New Haven (Demster Beach)	1	ND			3	ND	ND	ND
Ontario (Water Filtration Plant)	13	ND	ND	ND	12	ND	ND	ND
Oswego (City Hall Tap)	6	ND	1.0	ND	2	ND	ND	ND
Pawling (Pond at United Nuclear)	2	ND	ND	ND	NS			
Rhinecliff (Hudson River)	7	ND	ND	ND	8	ND	ND	ND
Tuxedo (Indian Kill, 150 feet below reservoir)	3	ND	ND	ND	3	ND	ND	ND
Wappinger (Hudson River)	6	ND	ND	ND	8	ND	ND	ND

[a] This station is on the Nuclear Fuels Services reprocessing plant site. ND, nondetectable. NS, no sample.

[b] Daily continuous sample.

Radioactivity in Washington Surface Water[1] July 1970–June 1971

Washington State Department of Social and Health Services

Radioanalysis of surface water samples collected through the State is one of the major functions of the Washington State Department of Social and Health Services radiation surveillance program. Some surface water samples are collected monthly or quarterly by the Washington State Department of Ecology. Selected stations on the Columbia River are sampled weekly or monthly by local health departments. Cedar River, a major water supply for the greater Seattle area, is sampled monthly by the City of Seattle Water Department. Figure 1 shows the surface water sampling locations and code numbers.

All water is collected in 2-liter polyethylene bottles by grab sampling and is mailed to the State radiation laboratory in Seattle for analysis. Some special analyses are performed by the National Environmental Research Center—Las Vegas (NERC-LV).

Analytical procedures

Surface water samples are analyzed for gamma-ray emitters and then separated into suspended and soluble fractions for gross beta counting. All Columbia River samples are also

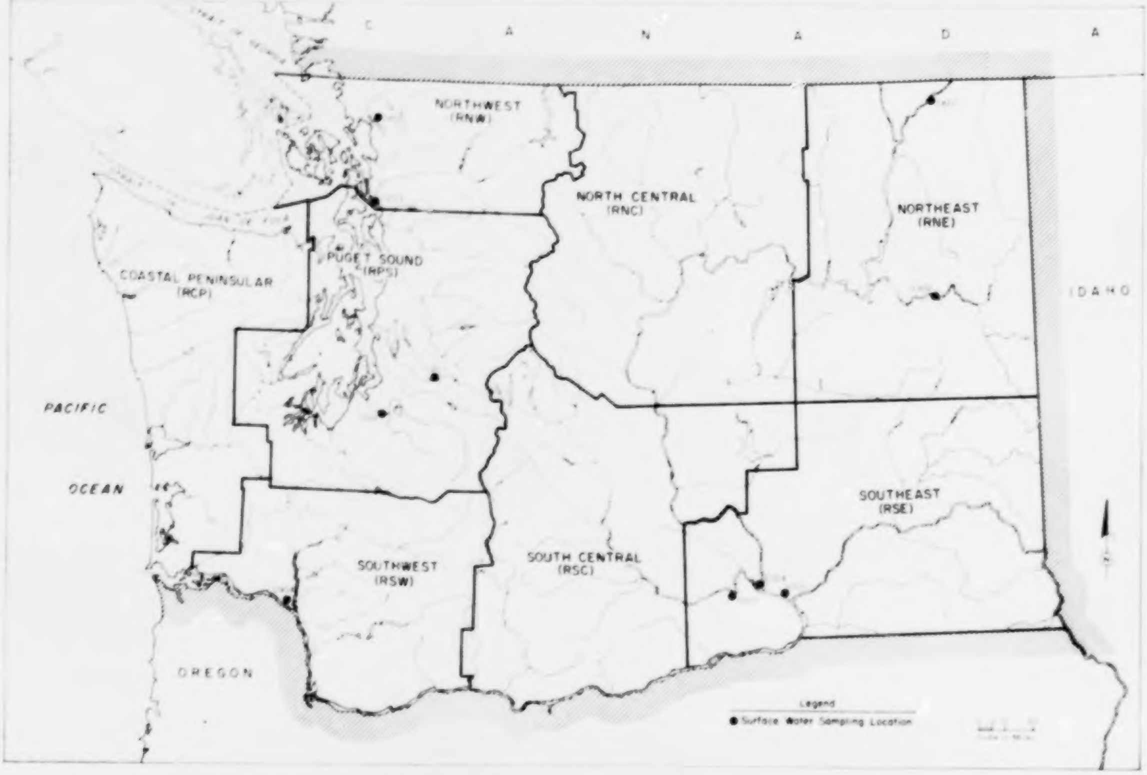
CANADA
NORTHWEST (RNW)
NORTH CENTRAL (RNC)
NORTHEAST (RNE)
IDAHO
COASTAL PENINSULAR (RCP)
PUGET SOUND (RPS)
PACIFIC
OCEAN
SOUTHEAST (RSE)
SOUTHWEST (RSW)
SOUTH CENTRAL (RSC)
OREGON
Legend
● Surface Water Sampling Location

Figure 1. Washington surface water sampling locations with code numbers

analyzed for phosphorus-32, a pure beta-particle emitter which is not detectable in the gamma-ray scan.

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[1] Summarized from "Environmental Radiation Surveillance in Washington State," Tenth Annual Report, July 1970–June 1971.

For the gamma radioanalysis, the samples are placed in stainless steel Marinelli beakers as soon after receipt as possible. Distilled water is added when necessary to obtain 2,000 ml geometry. After analysis by gamma spectroscopy, surface water (except Columbia River) is filtered through Whatman No. 42 filter paper. The filter paper containing the suspended solids is ashed in a muffle furnace at 600° C., plancheted, weighed, and submitted for gross beta counting. The filtrate, evaporated to near dryness, is quantatively transferred to a tared planchet, dried, weighed, and submitted for gross beta counting.

The gamma analysis of the Columbia River samples is started approximately 14 days after collection. After the gamma spectroscopic analysis, Columbia River samples are divided into two aliquots. One aliquot is prepared for standard gross beta counting as described above, while the second aliquot is prepared for phosphorus-32 counting. The technique used for phosphorus-32 separation is a modification of published methods (*1–4*). After a waiting period of 15 days following collection to allow arsenic-76 and other short-lived interfering radionuclides to decay, the phosphorus is separated from the interfering radionuclides by precipitation as ammonium phosphomolybdate from an acid medium. The precipitate is washed with ammonium nitrate, dissolved with 3N ammonium hydroxide, transferred into a tared planchet, dried, ashed at 450° C., weighed, and counted for beta radioactivity.

Analyses results of Columbia River samples are reported separately because of the unique isotopes present (table 1). The data reflect the more detailed laboratory analysis that Columbia River samples receive in order to document the

Table 1. Monthly average radioactivity in Columbia River water, July 1970–June 1971

Location and type of analysis	Concentration (pCi/liter)											
	1970						1971					
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Northport (code No. RNE 0601)												
Beta-particle:												
Suspended [a]	NS	<1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved [a]	NS	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	NS	3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Phosphorus-32 [b]	NS	<1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Gamma-ray [b]												
Chromium-51	NS	<100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Zinc-65	NS	<20	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Scandium-46	NS	<10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Richland (code No. RSE 0104)												
Beta-particle:												
Suspended [a]	129	46	67	178	195	3	124	12	10	2	8	6
Dissolved [a]	109	50	159	112	105	15	88	11	5	3	4	5
Total	238	96	226	290	300	18	212	23	15	5	12	11
Phosphorus-32 [b]	36	12	38	44	36	6	32	2	<1	<1	<1	<1
Gamma-ray [b]												
Chromium-51	397	380	890	785	643	200	493	<50	<50	<50	<50	<50
Zinc-65	<40	53	59	81	64	54	52	12	12	<10	<10	8
Scandium-46	117	89	131	265	142	<20	162	39	15	<5	6	8
Pasco (code No. RSE 0101)												
Beta-particle:												
Suspended [a]	13	14	12	32	5	4	6	19	1	1	2	1
Dissolved [a]	26	24	26	38	16	10	8	6	2	2	4	3
Total	39	38	38	70	21	14	14	25	3	3	6	4
Phosphorus-32 [b]	19	19	17	40	10	5	3	2	<1	<1	<1	<1
Gamma-ray [b]												
Chromium-51	304	348	350	570	<100	<100	<100	<50	<100	<100	<100	<100
Zinc-65	<20	34	43	44	<20	<20	<20	19	<20	<20	<20	<20
Scandium-46	19	23	21	52	22	24	22	87	<10	<10	<10	<10
Longview (code No. RSW 0904)												
Beta-particle:												
Suspended [a]	2	<1	<1	1	<1	3	NS	3	1	1	NS	NS
Dissolved [a]	4	5	3	5	5	6	NS	5	2	3	NS	NS
Total	6	5	3	6	5	9	NS	8	3	4	NS	NS
Phosphorus-32 [b]	1	<1	<1	2	1	3	NS	3	<1	<1	NS	NS
Gamma-ray [b]												
Chromium-51	<100	<100	<100	115	<100	<100	NS	<100	<100	<100	NS	NS
Zinc-65	<20	<20	<20	<20	<20	<20	NS	<20	<20	<20	NS	NS
Scandium-46	<10	<10	<10	<10	<10	<10	NS	<10	<10	<10	NS	NS

[a] Activity at time of counting. Strontium-90, yttrium-90 calibration standard.
[b] Results extrapolated to date of sample collection.
NS, no sample.

significant isotopes present. There are some short half-life isotopes such as sodium-24 (15 hour), arsenic-76 (27 hour), and neptunium-239 (56 hour) which are allowed to decay before analysis. This is due partly to the unavoidable delay occurring during transport of the sample to the laboratory and also because the decay of isotopes with half-life less than 2.5 days allows for a more accurate gamma analysis of the isotopes of chromium-51, zinc-65, and scandium-46.

Monthly averages of monitoring data from the Columbia River at Richland have been plotted to show the fluctuating concentrations encountered for the period 1964 through June 1971. Figures 2, 3, 4, and 5 show phosphorus-32, scandium-46, chromium-51, and zinc-65 concentrations, respectively. Plots of data for Pasco and Vancouver in previous annual reports have been replaced by the plots of data from Richland because of its closer proximity to the Hanford project.

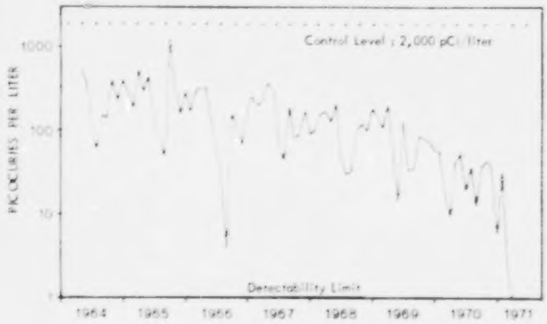

Figure 2. Phosphorus-32 monthly averages in Columbia river water, Richland, April 1964–June 1961

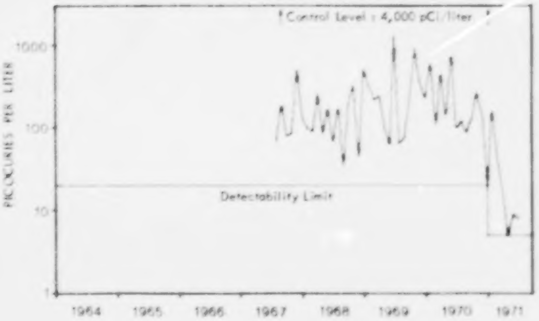

Figure 3. Scandium-46 monthly averages in Columbia river water, Richland, July 1967–1971

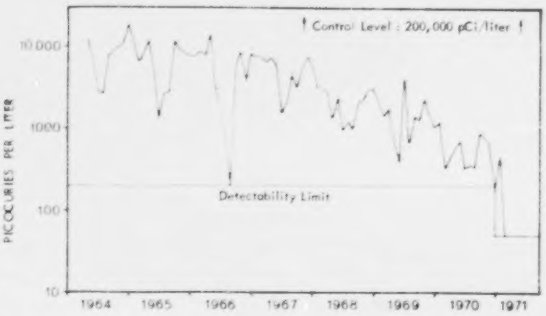

Figure 4. Chromium-51 monthly averages in Columbia river water, Richland, April 1964–June 1971

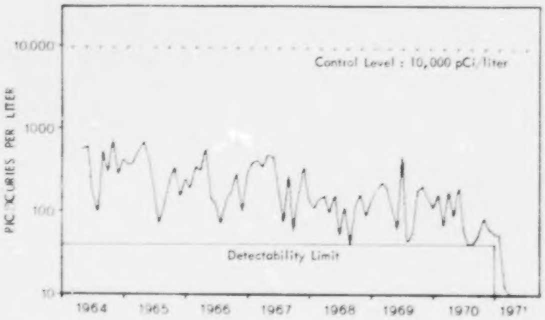

Figure 5. Zinc-65 monthly averages in Columbia river water, Richland, April 1964–June 1971

Concentrations of radioactivity in the Columbia River dropped below detectable limits following the shutdown on January 29, 1971, of the KE and the N reactors at Hanford. The KE reactor was the last of eight original plutonium producing reactors. These eight reactors used single pass cooling systems for the reactor core and were the major sources of radioactivity entering the Columbia River. The N reactor was designed for both plutonium and electrical power production. It uses a double loop cooling system so that river water used for cooling does not enter the reactor core. Its contribution of radioactivity to the river in comparison with the reactors using single pass cooling is negligible. Because of its critical value to the Northwest's energy supply, subsequent negotiations resulted in a reactivation of the N reactor.

Surface waters, other than the Columbia River, are sampled to monitor the combined effect of background and of atmospheric fallout

Table 2. Beta radioactivity[a] in Washington surface water (except for Columbia River) July 1970–June 1971

Sampling location	Concentrations (pCi/liter)											
	1970						1971					
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Cedar River (PS0201)												
Landberg:												
Suspended	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dissolved	<1	<1	<1	<1	1	<1	<1	<1	1	1	2	1
Lake Whatcom (NW0601)												
Bellingham:												
Suspended	<1	<1	<1	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved	2	2	2	NS	NS	NS	NS	NS	NS	NS	NS	NS
Puyallup River (PS1302)												
Puyallup:												
Suspended	4	2	11	NS	NS	NS	2	<1	<1	<1	<1	NS
Dissolved	2	2	3	NS	NS	NS	2	1	2	2	1	NS
Skagit River (NW0203)												
Conway:												
Suspended	NS	NS	NS	NS	NS	NS	<1	2	<1	<1	NS	<1
Dissolved	NS	NS	NS	NS	NS	NS	1	1	2	1	NS	2
Spokane River (NE0302)												
Long Lake:												
Suspended	NS	<1	<1	NS	NS	NS	2	<1	NS	1	<1	<1
Dissolved	NS	2	2	NS	NS	NS	2	2	NS	2	2	2
Yakima River (SE0201)												
Kiona:												
Suspended	NS	NS	NS	NS	NS	NS	1	<1	<1	<1	2	1
Dissolved	NS	NS	NS	NS	NS	NS	3	2	3	2	2	3

[a] Activity at time of counting. Strontium-yttrium-90 calibration standard. No detectable gamma activity present.
NS, no sample.

(table 2). Figure 6 shows annual average and maximum gross beta activity in surface water samples for the period 1963 through 1971. The 1967 peak of 26 pCi/liter on the plotted maximum values occurred in a Snake River sample resulting from fallout from the Chinese nuclear detonation of December 27, 1966. Other peak values on the plot were caused by high turbidity samples.

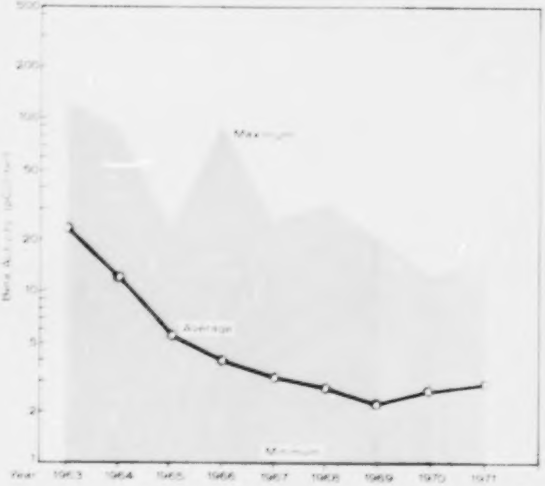

Figure 6. Average, maximum, and minimum beta radioactivity in surface waters (excluding the Columbia river), 1963–1971

Table 3 presents the individual sample results from the tritium analyses performed by the National Environmental Research Center—Las Vegas (NERC-LV).

Previous coverage in *Radiation Data and Reports:*

Period	Issue
July 1969–June 1970	March 1972

Table 3. Tritium[a] in Columbia River water July 1970–June 1971

Sampling location	Collection date	Concentration (pCi/liter)
Northport	10/5/1970	800
	10/18/1970	750
	2/10/1971	830
	3/5/1971	940
Pasco	10/2/1971	1,000
	1/15/1971	920
	4/6/1971	940
Longview	4/20/1971	720

[a] Analyses performed by National Environmental Research Center—Las Vegas (NERC-LV).

REFERENCES

(*1*) KOLTHOFF and SANDELL. Textbook of quantitative inorganic analysis, Revised Edition. The MacMillan Company, New York, N.Y. (1949), pp. 390–397; 713–717.

(*2*) HILLENBRAND, W. F. and G. LUNDELL. Applied inorganic analysis. John Wiley and Sons, Inc., New York, N.Y. (1953), pp. 694–710.

(*3*) FURMAN, N. H. Scotts' standard method of analysis, 5th Edition, Vol. 1. Van Nostrand Company, Inc., New York, N.Y. (1944), pp. 694–697.

(*4*) HANFORD ATOMICS PRODUCTS OPERATIONS. Radiological chemical analysis: River analysis manual—phosphorus-32 determination. Hanford Facility, Richland, Wash.

SECTION III. AIR AND DEPOSITION

Radioactivity in Airborne Particulates and Precipitation

Continuous surveillance of radioactivity in air and precipitation provides one of the earliest indications of changes in environmental fission product radioactivity. To date, this surveillance has been confined chiefly to gross beta radioanalysis. Although such data are insufficient to assess total human radiation exposure from fallout, they can be used to determine when to modify monitoring in other phases of the environment.

Surveillance data from a number of programs are published monthly and summarized periodically to show current and long-range trends of atmospheric radioactivity in the Western Hemisphere. These include data from activities of the Environmental Protection Agency, the Canadian Department of National Health and Welfare, and the Pan American Health Organization.

In addition to those programs presented in this issue, the following programs were previously covered in *Radiation Data and Reports.*

Network	Period	Issue
Plutonium in airborne particulates	October–December 1972	June 1973
Surface air sampling program, 80th Meridian Network, *HASL*	1970	May 1973
Mexican Air Monitoring Program	September–December 1972	June 1973

1. Radiation Alert Network
April 1973

Quality Assurance and Environmental Monitoring Laboratory, National Environmental Research Center—Research Triangle Park
Environmental Protection Agency

Surveillance of atmospheric radioactivity in the United States is conducted by the Radiation Alert Network (RAN) which regularly gathers samples at 68 locations distributed throughout the country (figure 1). Most of the stations are operated by State health department personnel.

The station operators perform "field estimates" on the airborne particulate samples at 5 hours after collection, when most of the radon daughter products have decayed, and at 29 hours after collection, when most of the thoron daughter products have decayed. They also perform field estimates on dried precipitation samples and report all results to appropriate Environmental Protection Agency officials by mail or telephone depending on levels found. A compilation of the daily field estimates is available upon request from the Quality Assurance and Environmental Monitoring Laboratory, NERC—RTP, EPA, Research Triangle Park, N.C. 27711. A detailed description of the sampling and analytical procedures was presented in the March 1968 issue of *Radiological Health Data and Reports.*

Table 1 presents the monthly average gross beta radioactivity in surface air particulates and deposition by precipitation, as measured by the field estimate technique, during April 1973.

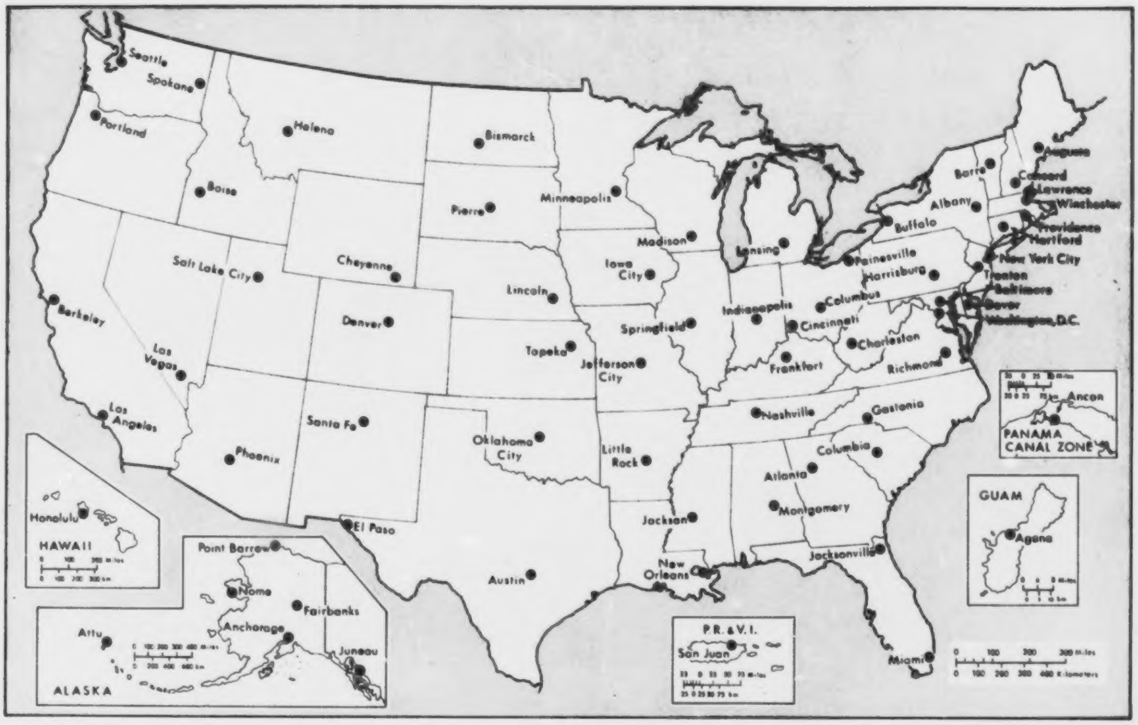
Seattle
Spokane
Portland
Helena
Bismarck
Boise
Pierre
Minneapolis
Augusta
Barre
Concord
Lawrence
Winchester
Albany
Providence
Hartford
Buffalo
Madison
Lansing
Painesville
New York City
Harrisburg
Trenton
Baltimore
Dover
Washington, D.C.
Salt Lake City
Cheyenne
Iowa City
Lincoln
Columbus
Berkeley
Denver
Indianapolis
Cincinnati
Springfield
Topeka
Charleston
Las Vegas
Jefferson City
Frankfort
Richmond
Los Angeles
Nashville
Gastonia
Santa Fe
Oklahoma City
Ancon
PANAMA CANAL ZONE
Phoenix
Little Rock
Columbia
Atlanta
GUAM
Agana
Montgomery
Honolulu
HAWAII
El Paso
Jackson
Point Barrow
Jacksonville
New Orleans
Nome
Austin
Fairbanks
Anchorage
Attu
Juneau
ALASKA
P.R. & V.I.
San Juan
Miami

Figure 1. Radiation Alert Network sampling stations

Table 1. Gross beta radioactivity in surface air and precipitation, April 1973

Station location		Number of samples	Gross beta radioactivity (5-hour field estimate) (pCi/m³)			Number of samples	Precipitation			
			Maximum	Minimum	Average [a]		Total depth (mm)	Field estimation of deposition		
								Number of samples	Depth (mm)	Total deposition (nCi/m²)
Ala:	Montgomery	19	1	0	0	5	224	5	224	23
Alaska:	Anchorage	2	0	0	0	0				
	Attu Island	30	0	0	0	0				
	Fairbanks	0				0				
	Juneau	0				0				
	Nome	0				0				
	Point Barrow	0				0				
Ariz.	Phoenix	16	6	0	2	0				
Ark:	Little Rock	0				0				
Calif:	Berkeley	20	0	0	0	0				
	Los Angeles	21	1	0	1	0				
C.Z:	Ancon	13	0	0	0	0				
Colo:	Denver	20	3	0	1	3	43	(b)		
Conn:	Hartford	18	0	0	0	11	136	11	136	0
Del:	Dover	19	1	0	0	0				
D.C:	Washington	24	0	0	0	0				
Fla:	Jacksonville	20	0	0	0	5	161	5	161	7
	Miami	5	0	0	0	0				
Ga.	Atlanta	0				0				
Guam:	Agana	0				0				
Hawaii:	Honolulu	20	0	0	0	0	12	(b)		
Idaho:	Boise	19	2	0	1	4	44	4	44	1
Ill:	Springfield	12	1	0	0	0				
Ind:	Indianapolis	17	1	9	0	0				
Iowa:	Iowa City	21	1	0	1	4	110	4	110	11
Kans:	Topeka	21	3	0	1	5	84	5	84	1
Ky:	Frankfort	12	1	0	0	0				
La:	New Orleans	20	1	0	0	6	329	(b)		
Maine:	Augusta	19	1	0	0	6	85	6	85	0
Md:	Baltimore	20	1	0	0	9	81	9	81	0
Mass:	Lawrence	20	1	0	0	7	168	7	168	0
	Winchester	20	1	0	0	7	145	7	145	0
Mich:	Lansing	19	1	0	0	8	43	8	43	3
Minn:	Minneapolis	18	2	0	1	4	43	4	43	11
Miss:	Jackson	6	0	0	0	2	48	2	48	0
Mo:	Jefferson City	19	1	0	0	4	73	4	73	5
Mont:	Helena	12	1	0	0	2	7	2	7	0
Nebr:	Lincoln	21	9	0	2	4	26	4	26	1
Nev:	Las Vegas	21	3	0	1	0				
N.H:	Concord	0				0				
N.J:	Trenton	15	1	0	0	9	186	9	186	6
N. Mex:	Santa Fe	14	2	0	1	0				
N.Y:	Albany	20	1	0	1	0				
	Buffalo	20	1	0	0	0				
	New York City	0				0				
N.C:	Gastonia	19	7	0	1	1	2			
N. Dak:	Bismarck	20	6	0	2	4	19	3	8	1
Ohio:	Cincinnati	0				0				
	Columbus	5	0	0	0	0				
	Painesville	21	1	0	0	10	106	10	106	26
Okla:	Oklahoma City	0				0				
Oreg:	Portland	21	1	0	0	5	42	5	42	1
Pa:	Harrisburg	17	1	0	0	0				
P.R:	San Juan	0				0				
R.I:	Providence	21	1	0	0	0				
S.C:	Columbia	7	1	0	0	2	147	2	147	0
S. Dak:	Pierre	4	3	2	2	0				
Tenn:	Nashville	20	1	0	0	10	162	10	162	0
Tex:	Austin	21	3	0	2	4	58	(b)		
	El Paso	20	3	1	1	0				
Utah:	Salt Lake City	29	2	0	1	11	59	11	59	11
Vt:	Barre	20	3	0	1	6	118	6	118	8
Va:	Richmond	16	0	0	0	2	44	2	44	1
Wash:	Seattle	9	0	0	0	5	27	(b)		
	Spokane	20	2	0	0	0				
W. Va:	Charleston	20	1	0	1	16	128	16	128	11
Wisc:	Madison	21	1	0	0	11	221	11	221	11
Wyo:	Cheyenne	9	1	0	1	0				
Network summary		973	9	0	0	194	118	6	100	5

[a] The monthly average is calculated by weighting the field estimates of individual air samples with length of sampling period.

[b] This station is part of the tritium surveillance system. No gross beta measurements are done.

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2. Air Surveillance Network, April 1973

National Environmental Research Center—Las Vegas,[1] *Environmental Protection Agency*

The Air Surveillance Network[2] (ASN), operated by the National Environmental Research Center—Las Vegas (NERC-LV), consists of 49 active and 73 standby sampling stations located in 21 western States (figures 2 and 3). The Network is operated in support of nuclear testing sponsored by the Atomic Energy Commission (AEC) at the Nevada Test Site (NTS), and at any other designated test-

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[1] Formerly the Western Environmental Research Laboratory.

[2] The ASN is operated under a Memorandum of Understanding (No. AT(26-1)-539) with the Nevada Operations Office, U.S. Atomic Energy Commission.

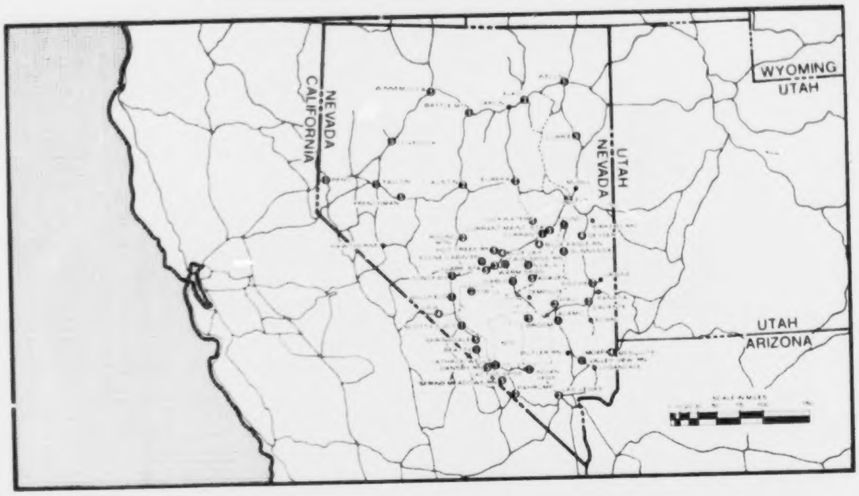
WYOMING
UTAH
NEVADA
CALIFORNIA
UTAH
NEVADA
UTAH
ARIZONA

Figure 2. NERC-LV Air Surveillance Network stations in Nevada

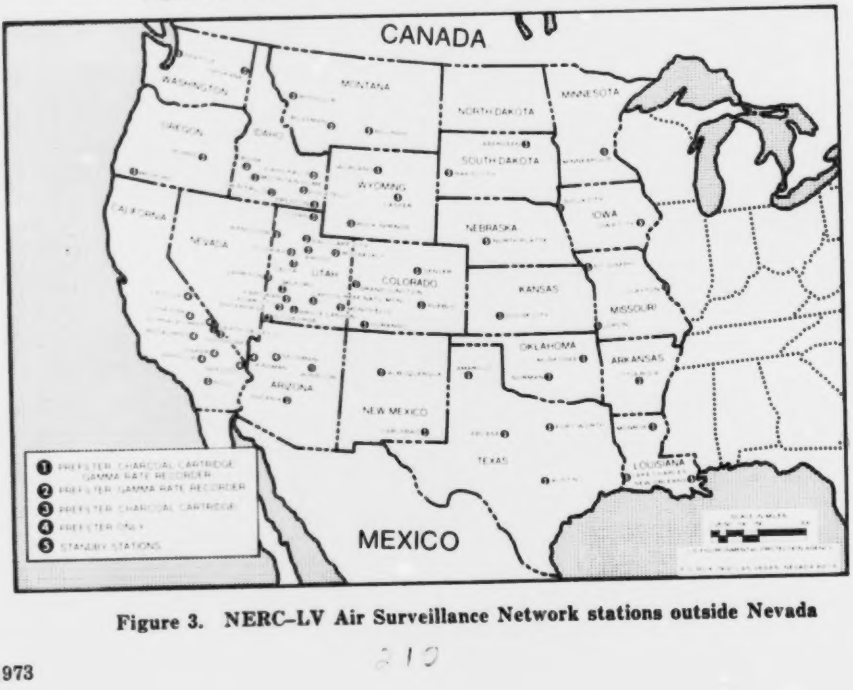
CANADA
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
OREGON
IDAHO
SOUTH DAKOTA
WYOMING
CALIFORNIA
NEVADA
NEBRASKA
IOWA
UTAH
COLORADO
KANSAS
MISSOURI
OKLAHOMA
ARKANSAS
ARIZONA
NEW MEXICO
TEXAS
LOUISIANA
MEXICO
1 PREFILTER, CHARCOAL CARTRIDGE, GAMMA RATE RECORDER
2 PREFILTER, GAMMA RATE RECORDER
3 PREFILTER, CHARCOAL CARTRIDGE
4 PREFILTER ONLY
5 STANDBY STATIONS

Figure 3. NERC-LV Air Surveillance Network stations outside Nevada

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ing sites.

The stations are operated by State health department personnel and by private individuals on a contract basis. All active stations are operated continuously with filters being exchanged over periods generally ranging from 24 to 72 hours. All samples are mailed to the NERC-LV unless special retrieval is arranged at selected locations in response to known releases of radioactivity from the NTS. A complete description of sampling and analytical procedures was presented in the February 1972 issue of *Radiation Data and Reports.*

Results

Table 2 presents the monthly average gross beta concentrations in air for each of the active network stations and of the standby stations, which are operated 1 week to check equipment operability. The highest gross beta concentration within the network was less than 0.2 pCi/m^3 at Joplin, Mo.; Duckwater, Blue Eagle Ranch, and Reno, Nev.; and Delta, Utah. The minimum reporting concentration for gross beta is 0.1 pCi/m^3. For averaging purposes, individual concentrations which are below the minimum detectable concentration (0.06 pCi/m^3) are assumed to be equal to the minimum detectable concentration. Averages less than the minimum reporting level (0.1 pCi/m^3) are reported as <0.1 pCi/m^3. No radionuclides were identified by gamma spectrometry on any filters or charcoal cartridges during April.

Complete copies of this summary and listings of the daily gross beta and gamma spectrometry results are distributed to EPA regional offices and appropriate State agencies. Additional copies of the daily results may be obtained from the NERC-LV upon written request.

Table 2. Summary of gross beta radioactivity concentrations in air, April 1973

Location		Number of samples	Concentration (pCi/m^3)		
			Maximum	Minimum	Average [a]
Ariz:	Kingman	30	<0.1	<0.1	0.1
	Phoenix	7	<.1	<.1	<.1
	Seligman	30	<.1	<.1	<.1
	Winslow	8	<.1	<.1	<.1
Ark:	Little Rock	4	<.1	<.1	<.1
Calif:	Baker	26	.1	<.1	.1
	Barstow	30	<.1	<.1	<.1
	Bishop	28	.1	<.1	.1
	Death Valley Junction	29	.1	<.1	.1
	Furnace Creek	30	.1	<.1	.1
	Indio	8	<.1	<.1	<.1
	Lone Pine	28	.1	<.1	.1
	Needles	25	<.1	<.1	<.1
	Ridgecrest	30	<.1	<.1	<.1
	Shoshone	30	.1	<.1	.1
Colo:	Denver	5	<.1	<.1	<.1
	Durango	7	<.1	<.1	<.1
Idaho:	Boise	6	<.1	<.1	<.1
	Idaho Falls	4	<.1	<.1	<.1
	Preston	8	<.1	<.1	<.1
	Twin Falls	8	<.1	<.1	<.1
Iowa:	Iowa City	5	<.1	<.1	<.1
	Sioux City	7	<.1	<.1	<.1
La:	Lake Charles	5	<.1	<.1	<.1
	Monroe	5	<.1	<.1	<.1
	New Orleans	5	<.1	<.1	<.1
Mo:	Clayton	4	<.1	<.1	<.1
	Joplin	8	<.2	<.1	.1
	St. Joseph	8	<.1	<.1	<.1
Nebr:	North Platte	7	<.1	<.1	<.1
Nev:	Alamo	30	.1	<.1	.1
	Austin	21	.1	<.1	.1
	Battle Mountain	7	<.1	<.1	<.1
	Beatty	29	.1	<.1	.1
	Blue Eagle Ranch (Currant)	28	<.2	<.1	.1
	Blue Jay	30	<.1	<.1	<.1
	Caliente	30	<.1	<.1	<.1
	Currant Ranch	21	<.1	<.1	<.1
	Currie	8	<.1	<.1	<.1
	Diablo	30	<.1	<.1	<.1
	Duckwater	26	<.2	<.1	.1
	Elko	8	<.1	<.1	<.1
	Ely	30	<.1	<.1	<.1
	Eureka	30	<.1	<.1	<.1
	Fallini's Twin Springs Ranch	30	.1	<.1	.1

See footnotes at end of table.

Table 2. Summary of gross beta radioactivity concentrations in air April 1973—continued

Location		Number of samples	Concentration (pCi/m^3)		
			Maximum	Minimum	Average [a]
Nev:	Fallon	7	<0.1	<0.1	<0.1
	Frenchman Station	8	<.1	<.1	<.1
	Geyser Maintenance Station	30	<.1	<.1	<.1
	Goldfield	29	<.1	<.1	<.1
	Groom Lake	21	.1	<.1	.1
	Hiko	29	.1	<.1	.1
	Indian Springs	30	<.1	<.1	<.1
	Las Vegas	21	<.1	<.1	<.1
	Lathrop Wells	30	<.1	<.1	<.1
	Lida	30	<.1	<.1	<.1
	Lund	30	<.1	<.1	<.1
	Mesquite	30	<.1	<.1	<.1
	Nyala	30	<.1	<.1	<.1
	Pahrump	27	<.1	<.1	<.1
	Pioche	27	<.1	<.1	<.1
	Reno	7	<.2	<.1	.1
	Round Mountain	30	<.1	<.1	<.1
	Scotty's Junction	30	<.1	<.1	<.1
	Stone Cabin Ranch	30	<.1	<.1	<.1
	Sunnyside	30	<.1	<.1	<.1
	Tonopah	30	<.1	<.1	<.1
	Tonopah Test Range	28	.1	<.1	.1
	Warm Springs	30	<.1	<.1	<.1
	Warm Springs Ranch	30	<.1	<.1	<.1
	Wells	7	<.1	<.1	<.1
	Winnemucca	8	<.1	<.1	<.1
N. Mex:	Albuquerque	5	<.1	<.1	<.1
	Carlsbad	6	<.1	<.1	<.1
Okla:	Muskogee	7	<.1	<.1	<.1
Oreg:	Medford	8	<.1	<.1	<.1
S. Dak:	Aberdeen	8	<.1	<.1	<.1
	Rapid City	6	<.1	<.1	<.1
Tex:	Abilene	6	<.1	<.1	<.1
	Amarillo	5	<.1	<.1	<.1
	Austin	5	<.1	<.1	<.1
	Fort Worth	7	<.1	<.1	<.1
Utah:	Bryce Canyon	7	<.1	<.1	<.1
	Cedar City	30	<.1	<.1	<.1
	Delta	30	<.2	<.1	<.1
	Dugway	8	<.1	<.1	.1
	Enterprise	7	<.1	<.1	<.1
	Garrison	30	<.1	<.1	<.1
	Logan	7	<.1	<.1	<.1
	Milford	28	<.1	<.1	<.1
	Monticello	4	<.1	<.1	<.1
	Parowan	7	<.1	<.1	<.1
	Provo	2	<.1	<.1	<.1
	Roosevelt	7	<.1	<.1	<.1
	Salt Lake City	7	<.1	<.1	<.1
	St. George	30	<.1	<.1	<.1
	Wendover	7	<.1	<.1	<.1
Wash:	Spokane	5	<.1	<.1	<.1
Wyo:	Rock Springs	8	<.1	<.1	<.1
	Worland	7	<.1	<.1	<.1

[a] Individual values less than the minimum detectable concentration (MDC) are set equal to the MDC for averaging. A monthly average less than the minimum reportable value of 0.1 pCi/m^3 is reported as <0.1.

3. Canadian Air and Precipitation Monitoring Program,[1] April 1973

Radiation Protection Division
Department of National Health and Welfare

The Radiation Protection Division of the Canadian Department of National Health and Welfare monitors surface air and precipitation in connection with its Radioactive Fallout Study Program. Twenty-four collection stations are located at airports (figure 4), where the sampling equipment is operated by personnel from the Meteorological Services Branch of the Department of Transport. Detailed discussions of the sampling procedures, methods of analysis, and interpretation of results of the radioactive fallout program are contained in reports of the Department of National Health and Welfare (*1–5*).

A summary of the sampling procedures and methods of analysis was presented in the May

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[1] Prepared from information and data obtained from the Canadian Department of National Health and Welfare, Ottawa, Canada.

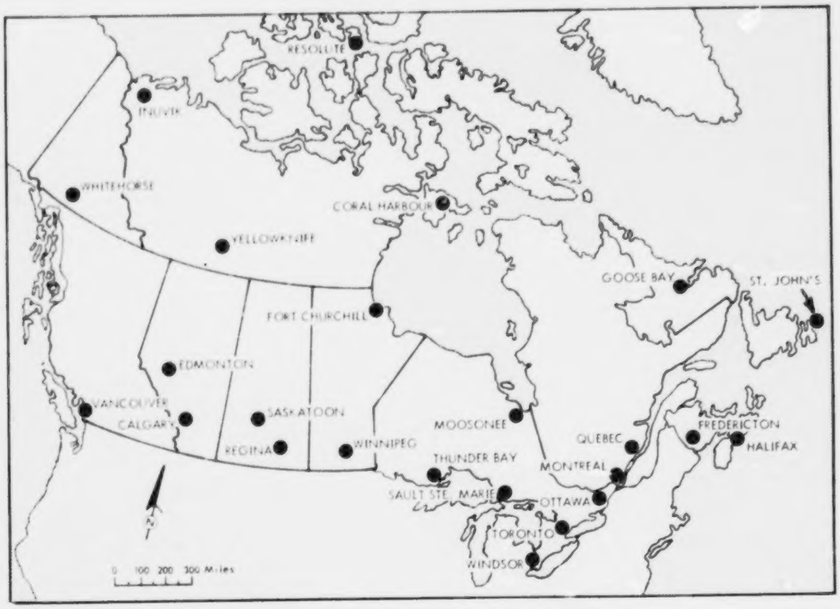
RESOLUTE
INUVIK
WHITEHORSE
CORAL HARBOUR
YELLOWKNIFE
GOOSE BAY
ST. JOHN'S
FORT CHURCHILL
EDMONTON
VANCOUVER
CALGARY
SASKATOON
REGINA
WINNIPEG
MOOSONEE
QUEBEC
FREDERICTON
HALIFAX
THUNDER BAY
MONTREAL
SAULT STE. MARIE
OTTAWA
TORONTO
WINDSOR
N
0 100 200 300 Miles

Figure 4. Canadian air and precipitation monitoring program

Table 3. Canadian gross beta radioactivity in surface air and precipitation, April 1973

Station	Number of samples	Air surveillance gross beta radioactivity (pCi/m³)			Precipitation measurements	
		Maximum	Minimum	Average	Average concentration (pCi/liter)	Total deposition (nCi/m²)
Calgary	5	0.01	0.01	0.01	25	0.7
Coral Harbour	5	.03	.01	.02	NS	NS
Edmonton	5	.02	.01	.01	11	.5
Ft. Churchill	5	.03	.01	.02	13	.1
Fredericton	5	.02	.01	.02	6	.7
Goose Bay	5	.02	.01	.01	NS	NS
Halifax	5	.03	.01	.02	7	.8
Inuvik	4	.03	.02	.02	36	.3
Montreal	5	.02	.01	.02	9	.6
Moosonee	4	.03	.02	.03	5	.2
Ottawa	5	.02	.01	.01	3	.3
Quebec	5	.02	.01	.01	8	.6
Regina	5	.02	.01	.01	16	.9
Resolute	5	.03	.02	.03	81	.1
St. John's, Nfld	3	.02	.01	.01	13	.6
Saskatoon	5	.02	.01	.02	14	.8
Sault Ste. Marie	5	.03	.01	.02	14	.8
Thunder Bay	5	.02	.01	.02	11	.4
Toronto	2	.02	.01	.02	12	.8
Vancouver	3	.01	.01	.01	42	.5
Whitehorse	5	.01	.01	.01	19	.2
Windsor	4	.02	.01	.01	17	.6
Winnipeg	5	.02	.01	.02	37	.8
Yellowknife	5	.02	.01	.01	47	.4
Network summary	110	0.03	0.01	0.02	20	0.5

NS, no sample available.

1969 issue of *Radiological Health Data and Reports.*

Surface air and precipitation data for April 1973 are presented in table 3.

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4. Pan American Air Sampling Program April 1973

Pan American Health Organization and U.S. Environmental Protection Agency

Gross beta radioactivity in air is monitored by countries in the Americas under the auspices of the collaborative program developed by the Pan American Health Organization (PAHO) and the Environmental Protection Agency (EPA) to assist PAHO-member countries in developing radiological health programs.

The air sampling station locations are shown in figure 5. Analytical techniques were described in the March 1968 issue of *Radiological Health Data and Reports.* The April 1973 air monitoring results from the participating countries are given in table 4.

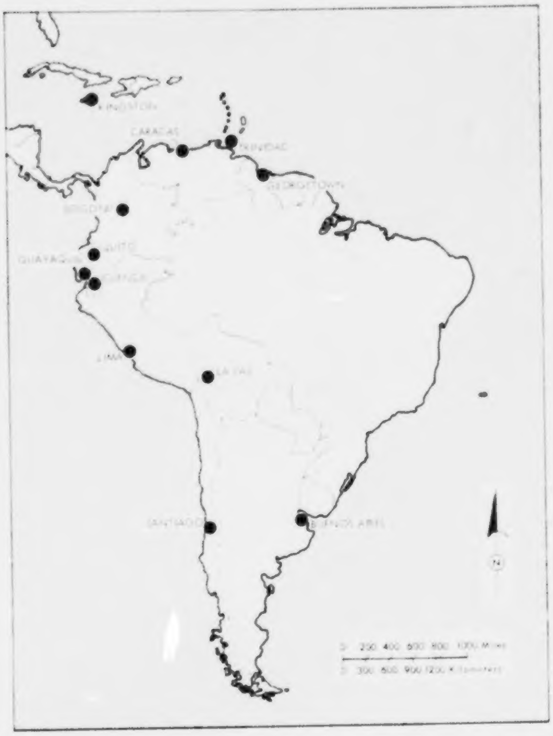

Figure 5. Pan American Air Sampling Program stations

Table 4. Summary of gross beta radioactivity in Pan American surface air, April 1973

Station location		Number of samples	Gross beta radioactivity (pCi/m³)		
			Maximum	Minimum	Average [a]
Argentina:	Buenos Aires	0			
Bolivia:	La Paz	15	0.02	0.00	0.01
Chile:	Santiago	15	.03	.00	.02
Colombia:	Bogota	17	.04	.00	.01
Ecuador:	Cuenca	6	.05	.00	.01
	Guayaquil	14	.06	.00	.01
	Quito	2	.00	.00	.00
Guyana:	Georgetown	9	.02	.00	.00
Jamaica:	Kingston	0			
Peru:	Lima	0			
Venezuela:	Caracas	8	.05	.00	.01
West Indies:	Trinidad	9	.07	.03	.05
Pan American summary		105	0.07	0.00	0.01

[a] The monthly average is calculated by weighting the individual samples with length of sampling period. Values less than 0.005 pCi/m³ are reported and used in averaging 0.00 pCi/m³.

5. California Air Sampling Program April 1973

Bureau of Radiological Health
California State Department of Public Health

The Bureau of Radiological Health of the California State Department of Public Health with the assistance of several cooperating agencies and organizations operates a surveillance system for determining radioactivity in airborne particulates. The air sampling locations are shown in figure 6.

All air samples are sent to the Sanitation and Radiation Laboratory of the State Department of Public Health where they are analyzed for their radioactive content.

Airborne particles are collected by a continuous sampling of air filtered through a 47 millimeter membrane filter, 0.8 micron pore size, using a Gast air pump of about 2 cubic feet per minute capacity, or 81.5 cubic meters per day. Air volumes are measured with a direct reading gas meter. Filters are replaced every 24 hours except on holidays and weekends. The filters are analyzed for gross alpha and beta radioactivity 72 hours after the end of the collection period. The daily samples are then composited into a monthly sample for gamma spectroscopy and an analysis for strontium-89 and strontium-90. Table 5 presents the monthly gross beta radioactivity in air for April 1973. The monthly sample results are presented quarterly.

Table 5. Gross beta radioactivity in California air April 1973

Station location	Number of samples	Gross beta radioactivity (pCi/m³)		
		Maximum	Minimum	Average
Bakersfield	30	0.89	0.01	0.20
Barstow	30	.87	.01	.14
Berkeley	30	.66	.00	.08
El Centro	30	.81	.04	.13
Eureka	26	.20	.00	.04
Fresno	28	.86	.00	.18
Los Angeles	30	.35	.00	.08
Redding	27	.15	.00	.07
Sacramento	30	.47	.02	.09
Salinas	29	5.65	.04	.50
San Bernardino	28	.45	.00	.11
San Diego	30	.26	.03	.07
San Luis Obispo	20	.59	.00	.11
Santa Rosa	30	.22	.00	.07
Summary	398	5.65	0.00	0.13

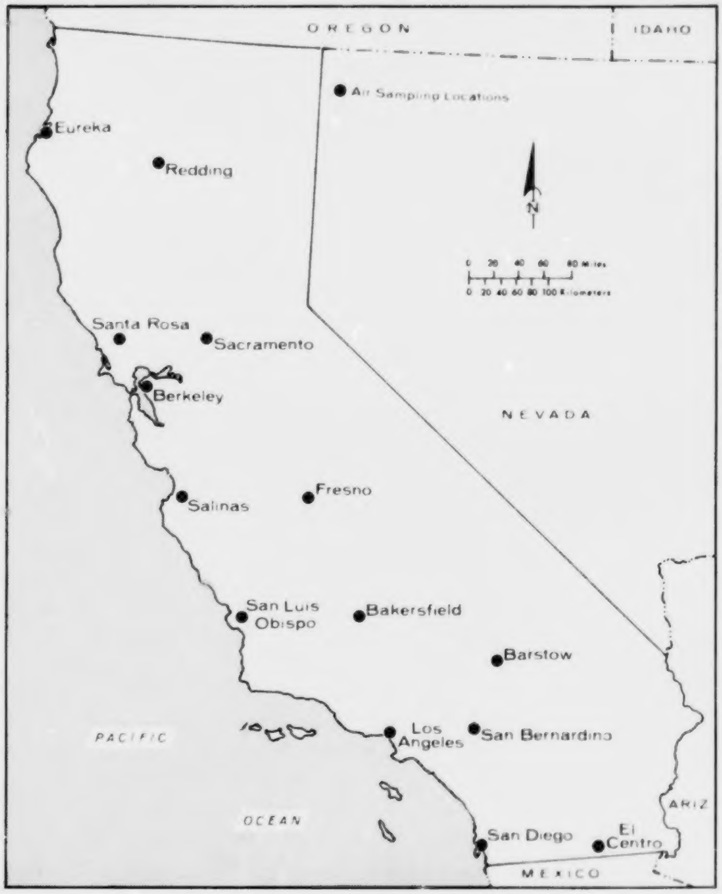
OREGON
IDAHO
Air Sampling Locations
N
0 20 40 60 80 Miles
0 20 40 60 80 100 Kilometers
Eureka
Redding
Santa Rosa
Sacramento
Berkeley
NEVADA
Salinas
Fresno
San Luis Obispo
Bakersfield
Barstow
PACIFIC
Los Angeles
San Bernardino
OCEAN
ARIZ
San Diego
El Centro
MEXICO

Figure 6. California air sampling program stations

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(*1*) BIRD, P. M., A. H. BOOTH, and P. G. MAR. Annual report of 1959 on the Radioactive Fallout Study Program, CNHW-RP-3. Department of National Health and Welfare, Ottawa, Canada (May 1960).

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(*3*) MAR, P. G. Annual report for 1961 on the Radioactive Fallous Study Program, CNHW-RP-5. Department of National Health and Welfare, Ottawa, Canada (December 1962).

(*4*) BEALE, J. and J. GORDON. The operation of the Radiation Protection Division Air Monitoring Program, RPD-11. Department of National Health and Welfare, Ottawa, Canada (July 1962).

(*5*) BOOTH, A. H. The calculation of permissible levels of fallout in air and water and their use in assessing the significance of 1961 levels in Canada, RPD-21. Department of National Health and Welfare, Ottawa, Canada (August 1962).

Fallout in the United States and Other Areas [1]
January–December 1971

Health and Safety Laboratory
Atomic Energy Commission

Monthly fallout deposition rates for strontium-90 are determined by the Health and Safety Laboratory (HASL) for 33 sites in the United States and 90 locations in other countries. HASL data from all of the active United States stations and other selected points in the Western Hemisphere (figure 1) covering the period from January–December 1971 are summarized in tables 1 and 2. All the stations of the 80th Meridian Network are represented.

Methods of collection

Two methods of fallout collection are employed by HASL. In the first, precipitation and dry fallout are collected for a period of 1 month in a stainless-steel pot with an exposed area of 0.076 m^2. At the end of the collection period, the contents are transferred, by careful scrubbing with a rubber spatula, to a polyethylene sample bottle which is then shipped to the laboratory for analysis.

The second method involves the use of a polyethylene funnel, with an exposed area of 0.072 m^2, attached to an ion exchange column. After a 1-month collection, the inside of the funnel is wiped with a tissue, and the tissue is inserted in the end of the column, which is then sealed and sent to HASL for analysis. It has been shown that at the 95-percent confidence level there was no significant difference in the strontium-90 measurements obtained from samples collected by the two methods (*1*).

REFERENCE

(*1*) ONG, L. D. Y. Homogeneity between pot and ion exchange column strontium-90 measurements. Fallout Program Quarterly Summary Report, HASL–135: 256–269. Office of Technical Services, Department of Commerce, Washington, D.C. (April 1, 1963).

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[1] The data in this article were taken from "Fallout Program Quarterly Summary Report," HASL–273: A–1 to A–310.

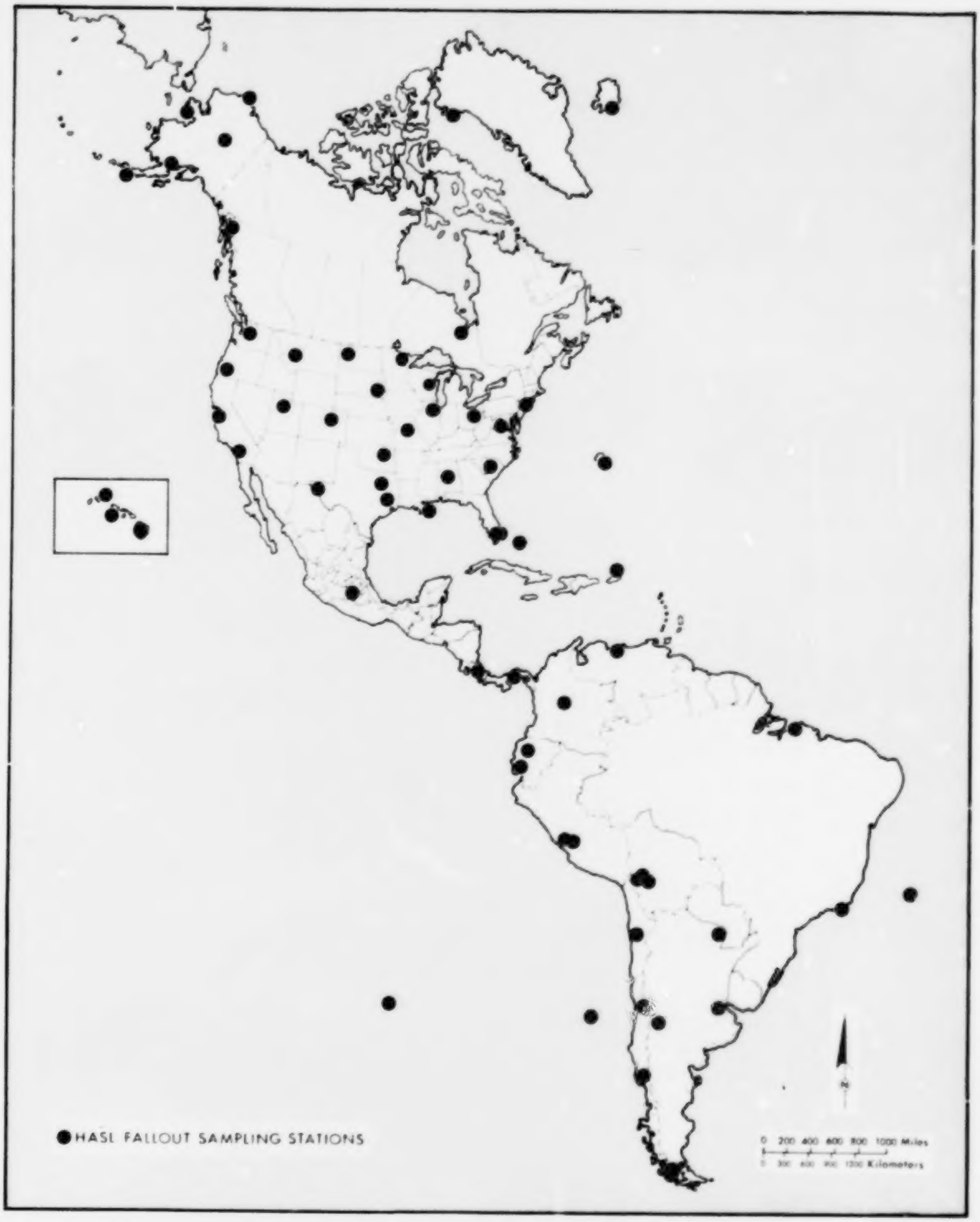
HASL FALLOUT SAMPLING STATIONS
0 200 400 600 800 1000 Miles
Kilometers

Figure 1. HASL fallout sampling stations in the Western Hemisphere

Table 1. Strontium-90 fallout in the United States, HASL, January–December 1971

Sampling location		Type of collection	Deposition (nCi/m²)											
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Ala:	Birmingham	pot	0.06	(b)	0.21	0.15	(b)	0.53	0.24	0.07	0.02	0.02	0.03	0.05
Alaska:	Anchorage	column	(a)	0.07	(a)	.03	.02	.08	.35	(a)	(a)	.05	.02	.02
	Cold Bay	column	.01	.03	(a)	.02	.10	.07	.04	.09	.09	.05	.04	.07
	Fairbanks	column	.01	(b)	.01	(b)	(a)	.07	.19	(b)	(b)	(b)	(b)	(b)
	Juneau	column	.09	.10	.02	.09	.09	.06	.09	.14	.02	.10	.04	.02
	Nome	column	(a)	(a)	(a)	(a)	.05	.11	.08	(b)	(b)	.05	(a)	(a)
Calif:	W. Los Angeles	pot	(a)	.02	.03	(b)	.05	.02	(a)	(a)	(a)	(a)	(a)	.08
	San Francisco	column	.04	[c] .04	[c] .04	.06	.06	.02	(a)	(a)	(a)	(a)	.02	.06
Colo:	Denver	column	(a)	.02	(a)	[c] .15	[c] .14	.28	.09	.05	.08	(a)	(a)	.02
Fla:	Coral Gables	pot	(a)	(a)	.03	.05	.08	.34	(b)	(b)	(b)	(b)	(b)	(b)
	Miami	column	.02	.02	.02	.04	.10	.26	.12	.08	.05	.05	.01	(b)
Hawaii:	Honolulu	pot	.23	(b)	(b)	(b)	(b)	.22	.10	(b)	.05	.02	.14	.10
	Lihue	column	.08	[c] .13	[c] .13	.08	.06	.10	.07	.04	.04	.02	.02	.03
	Mauna Loa	column	.02	.01	.01	.14	.05	.04	.02	(a)	.01	(a)	(a)	(a)
Ill:	Argonne	pot	.03	.05	.11	.10	.35	.24	.20	.11	.06	.02	.05	.04
La:	New Orleans	column	.91	.07	.13	.10	.08	.31	.10	.05	.04	(a)	(a)	(a)
Minn:	International Falls	column	(a)	.02	.02	.07	.24	.74	.26	.09	.09	.06	.02	(a)
Mo:	Columbia	column	(a)	.08	.03	.18	.24	.14	.22	.05	.08	.03	.04	.06
Mont:	Helena	column	.02	.03	.01	.07	.21	.22	.16	.10	.05	.02	(a)	(a)
N.Y:	New York City	pot	.04	.12	.18	.14	.30	.13	.20	.10	.06	.04	.06	.04
N. Dak:	Williston	column	.01	.01	.01	.12	.45	.56	.23	.06	.11	.02	(a)	(a)
Ohio:	Wooster	pot	.03	.08	.03	.05	.18	.26	.09	.05	.02	.02	.04	.01
Okla:	Tulsa	pot	(a)	.08	.02	.21	.43	.31	.18	.04	.25	.06	.04	.08
Oreg:	Medford	column	.03	[c] .02	[c] .02	.06	.11	.08	.04	.04	.03	.02	.02	.02
S.C:	Columbia	column	(b)	.17	.09	.15	.13	[c] .12	[c] .12	.10	.01	(a)	.07	.02
S. Dak:	Vermillion	pot	(a)	.15	.09	.25	.27	.72	.28	.04	.06	.06	.03	(a)
Tex:	Dallas	column	.01	[c] .04	[c] .04	.28	.28	.08	.10	.04	.02	.03	.03	.04
	El Paso	column	.02	.02	(a)	.16	(a)	.02	.09	.11	.04	.03	(a)	(a)
	Houston	column	.02	.03	.04	.11	.17	.04	.06	.09	.04	.02	.02	.04
Utah:	Salt Lake City	pot	.04	.09	.09	.36	.46	.36	.05	.06	.04	.10	.08	.04
Va:	Sterling	column	.05	.11	.04	.11	.27	.16	.09	.09	.03	.02	.02	(a)
Wash:	Forks	column	.22	.19	.32	.31	.22	.22	.10	.08	.06	.12	.03	(a)
Wis:	Green Bay	column	.03	.03	.04	.16	.18	.18	[c] .23	.23	.05	(a)	.03	.02

[a] Zero or trace.
[b] Data not available.
[c] Proportioned from originally consolidated data.

Table 2. Strontium-90 fallout in North and South America, HASL, January–December 1971

Sampling location		Type of collection	Deposition (nCi/m²)											
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Argentina:	Buenos Aires	column	0.07	0.16	0.05	0.03	0.07	0.04	0.09	0.04	0.21	0.16	0.07	0.17
	Formosa	column	.04	.06	.03	(a)	(a)	.06	.03	.18	.15	.12	.02	.05
	Malargue	column	.02	.04	.04	.02	.01	.02	.04	.12	.01	.02	(a)	.04
Bahama	Bimini	column	.02	.03	.02	.03	.25	.12	.07	.04	.03	(b)	(b)	(b)
Bermuda:	Kindley AFB	column	.08	.02	.17	.16	.19	.19	.07	.10	.05	.13	(b)	(b)
Bolivia:	Chacaltaya	column	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	.02	.03	.01
	La Paz (city)	column	.02	.01	.01	(a)	(a)	(a)	(a)	(a)	.03	.02	.02	.02
	La Paz (Ovejuyo)	column	(a)	.02	(a)	.02	(a)	(a)	(a)	(a)	(a)	(a)	(a)	.01
Brazil:	Belem	column	.03	.02	.03	.02	.02	.04	.04	.02	.07	.07	(a)	.03
	Rio de Janeiro	column	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
	Trindade Island	column	.03	.01	.01	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Canada:	Moosonee	column	(a)	.02	(a)	.07	.12	.23	.36	.16	.04	.09	.01	(a)
Chile:	Antarctica	column	(b)	.03	.05	.03	(a)	(a)	(a)	.02	(a)	.04	.02	.01
	Antofagasta	column	(a)	(a)	(b)	(a)	(b)	(a)	(a)	(a)	(b)	(b)	(b)	(a)
	Conception	column	(b)	(b)	(b)	(b)	.08	.12	.25	.09	.14	.03	(b)	(b)
	Easter Island	column	.04	.06	(a)	.04	.07	.03	.07	.04	.08	.08	.05	.06
	Puerto Montt	column	.12	.10	.09	.09	(b)	.09	.24	(b)	.15	.08	.13	.18
	Punta Arenas	column	(a)	.04	(b)	(a)	.02	.02	.02	.08	.08	.04	(a)	(b)
	Santiago	pot	.01	(a)	(a)	(a)	.02	.09	.02	.07	.03	.07	(a)	(a)
	Santiago	column	.01	(a)	(a)	.01	.02	.08	.17	.04	.03	.07	.01	.05
	Temuco	column	.11	[c].04	[c].04	[c].04	.07	.10	.26	.11	.09	(b)	(b)	(b)
Colombia:	Bogota	pot	(b)	(b)	.02	(a)	(a)	(b)	(b)	(a)	(a)	(a)	(a)	(a)
Costa Rica:	Turrialba	column	(a)	(a)	.05	.07	.04	.09	.09	.04	(a)	.02	.02	.01
Equador:	Guayaquil	column	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
	Quito	column	(a)	.01	(a)	(a)	(a)	(a)	(a)	(a)	(a)	.01	.01	(a)
Greenland:	Thule	column	(b)	(a)	(a)	.01	(a)	.04	.03	.08	.02	(a)	(a)	.03
Iceland:	Keflavik	column	(b)	.05	.06	.10	.13	.04	.11	.11	.05	.05	.03	.06
Mexico:	Mexico City	column	(a)	.02	(a)	.03	.05	(a)	(b)	.04	(a)	.01	(a)	(a)
Peru:	Lima	column	(a)	(a)	(b)	(a)	(a)	.04	(a)	.02	(a)	.01	.02	.01
Puerto Rico:	San Juan	column	.01	(b)	(b)	.23	(b)	.14	[c].06	[c].07	.02	.04	.01	(a)
Venezuela:	Caracas (site 1)	column	(a)	(a)	(a)	(a)	.03	.04	(b)	.04	.01	.01	(b)	(a)
	Caracas (site 2)	column	(b)	(b)	(b)	.03	(b)	(b)	(b)	(b)	.01	(b)	(b)	(b)

[a] Zero or trace.
[b] Data not available.
[c] Indicates proportioned from originally consolidated data.

SECTION IV. OTHER DATA

This section presents results from routine sampling of biological materials and other media not reported in the previous sections. Included here are such data as those obtained from human bone sampling, Alaskan surveillance, and environmental monitoring around nuclear facilities.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission (AEC) receives from its contractors annual reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant environmental surveys are required.

Releases of radioactive materials from AEC installations are governed by radiation standards set forth by AEC's Division of Operational Safety in directives published in the "AEC Manual."[1]

A summary of the environmental radioactivity data follows for Atomics International.

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[1] Title 10, Code to Federal Regulations, Part 20, "Standards for Protection Against Radiation," contains essentially the standards published in Chapter 0524 of the AEC Manual.

1. Atomics International[2]
January–December 1971

North American Rockwell Corporation
Canoga Park, Calif.

Atomics International, a division of North American Rockwell Corporation, has engaged in atomic energy research and development since 1946. The company designs, develops, and constructs nuclear reactors for central station and compact power plants for medical, industrial, and scientific applications.

The company headquarters is located in Canoga Park, Calif., approximately 23 miles northwest of downtown Los Angeles. The 290-acre Nuclear Development Field Laboratory (Santa Susana Facility), equipped with extensive testing facilities for the support of advanced nuclear studies, is located in the Simi Hills of Ventura County, approximately 29 miles northwest of downtown Los Angeles. The location of the above sites in relation to nearby communities is shown in figure 1.

The basic concept of radiological hazard control at Atomics International requires adequate containment of radioactive materials and, through rigid operational controls, minimizes effluent releases and external radiation levels. The environmental monitoring program provides a measure of the effectiveness of the company's radiological safety procedures and of engineering safeguards incorporated into facility designs.

The onsite environs of Atomics International headquarters and Nuclear Development Field Laboratory (NDFL) are surveyed monthly to determine the concentration of radioactivity in typical surface soil, vegetation, and water samples. The offsite environs are sampled monthly, except for soil and vegetation which

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[2] Summarized from "Environmental Monitoring, Annual Report, January 1, 1971 to December 31, 1971," Atomics International, Division of North American Rockwell Corporation.

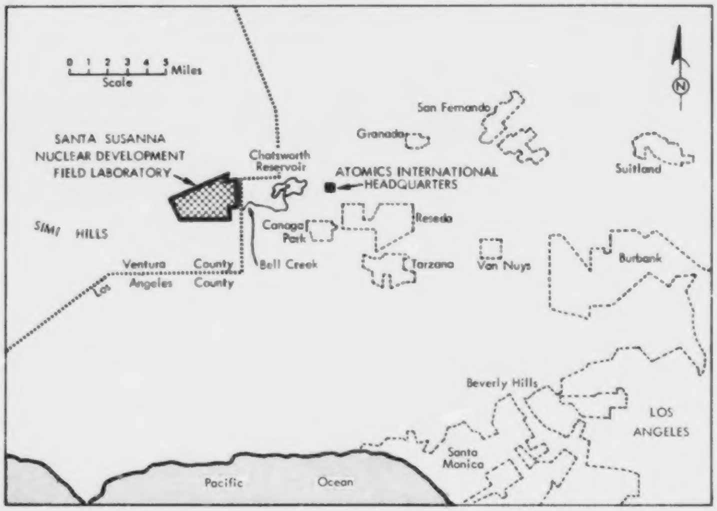
0 1 2 3 4 5 Miles
Scale
SANTA SUSANNA NUCLEAR DEVELOPMENT FIELD LABORATORY
SIMI HILLS
Ventura County
Los Angeles County
Chatsworth Reservoir
Bell Creek
Canoga Park
ATOMICS INTERNATIONAL HEADQUARTERS
San Fernando
Granada
Reseda
Tarzana
Van Nuys
Burbank
Suitland
N
Beverly Hills
LOS ANGELES
Santa Monica
Pacific Ocean

Figure 1. Atomics International facilities and vicinity

are sampled quarterly. Continuous environmental air monitoring at the sites provides information concerning long-lived airborne particulate radioactivity. A site perimeter radiation monitoring program using thermoluminescent dosimetry (TLD) was begun in 1971.

Counting and calibration procedures

The determination of radioactivity in all environmental soil, vegetation, water, and air samples is performed with a low-background proportional counting system capable of simultaneous counting of both alpha and net beta radioactivity. The sample-detector configuration provides a nearly 2π geometry. The thin-window detector is continually purged with methane counting gas. A preset time mode of operation is used for all samples; however, an overriding preset count mode is available to limit the counting time for high activity samples.

The minimum detection limits shown in table 1 were determined by using typical values for counting time, system efficiency, background count rates (approximately 0.05 cpm alpha and 1.0 cpm beta-gamma) and sample size. In addition, the minimum statistically significant amount of radioactivity, irrespective of sample configuration, is established as that amount equal in count rate to three times the standard deviation of the system background count rate.

Table 1. Minimum radioactivity detection limits Atomic International, January–December 1971

Sample	Type of radioactivity	Minimum detection limits (standard error)
Soil	Alpha	0.05 ± 0.03 (pCi/g)
	Beta-gamma	.22 ± .11 (pCi/g)
Vegetation	Alpha	.10 ± .06 (pCi/g-ash)
	Beta-gamma	.35 ± .18 (pCi/g-ash)
Water	Alpha	.20 ± .12 (pCi/liter)
	Beta-gamma	.63 ± .32 (pCi/liter)
Air	Alpha	8.5 ± 5.3 (fCi/m³)
	Beta-gamma	18 ± 9.3 (fCi/m³)

Counting system efficiencies are determined routinely with RaD+E+F (with alpha absorber), thorium-230, and uranium-235 standard sources, and with potassium-40 in the form of standard reagent grade KCl, which is used to simulate soil and vegetation samples. Self-absorption standards are made by dividing sieved KCl into samples beginning with a 100 milligram sample and increasing in mass by 200-milligram increments from 200 to 3,000 milligrams. The samples are placed in copper planchets of the type used for environmental samples and counted. The ratio of sample activity to the observed net count for each sample is plotted as a function of sample weight (figure 2). The correction factor (ratio) corre-

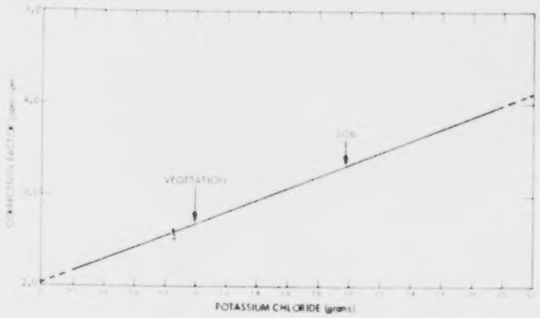

Figure 2. Sample self-absorption graph

sponding to sample weight is obtained from the graph. The product of the correction factor and the net sample count rate yields the sample activity (dpm). This method has been proved usable by applying it to variously sized aliquots of uniformly mixed environmental samples and observing that the resultant specific activities fall within the expected statistical counting error.

Air monitoring

Environmental air sampling is conducted continuously at the headquarters and NDFL sites with automatic sequential air samplers operating on 24-hour sampling cycles. Airborne particulate radioactivity is collected on HV-70 filter paper which is automatically changed at the end of each sampling period. The filter is removed from the sampler and counted after the radioactivity is allowed to decay for at least 72 hours. The volume of a typical daily environmental air sample is approximately 20 cubic meters. The average concentration of long-lived beta-gamma radioactivity on airborne particulates is presented in table 2.

Table 2. Radioactivity in air, Atomics International January–December 1971

Location	Type of radioactivity	Number of samples	Average concentration (fCi/m^3)
Headquarters	Alpha	730	8.7
	Beta-gamma	730	300
NDFL	Alpha	2,476	8.6
	Beta-gamma	2,476	330

When abnormally high airborne radioactivities are observed, the beta-gamma radioactivity decay data are plotted to determine the presence of short-lived isotopes other than naturally occurring radon, thoron, and daughters. If fallout is suspected, the decay characteristics are observed. If the radioactivity decays as a function of $t^{-1.2}$, the data curve is extrapolated in order to determine the date of origin. This data is compared with the dates of publicized nuclear detonations to determine if the abnormal airborne radioactivity was caused by such detonations.

Water monitoring

Process water used at the NDFL is obtained from Ventura County Water District No. 10 and distributed onsite by the same piping system previously used when process water was supplied by onsite wells. Pressure is provided by elevated storage tanks, one 50,000-gallon and one 500,000-gallon tank onsite. While clinically potable, the water is not used for drinking. Bottled potable water is delivered by a vendor and is not analyzed. Water from the pipe system is sampled monthly at two locations. The average process water radioactivity concentration is presented in table 3.

Table 3. Process water radioactivity, NDFL site January–December 1971

Type of radioactivity	January-June 1971		July-December 1971	
	Number of samples	Average concentration (pCi/liter)	Number of samples	Average concentration (pCi/liter)
Alpha	12	0.32	12	0.24
Beta-gamma	12	4.9	12	4.8

Surface discharged waters from NDFL facilities drain into holding reservoirs on adjacent Santa Susana Field Laboratory (SSFL) property. When full, the main reservoir is drained into Bell Creek, a tributary of the Los Angeles River in the San Fernando Valley, Los Angeles County. Pursuant to the requirements of Los Angeles Regional Water Quality Control Board Resolution 66–49, an environmental sampling station has been established in Bell

Table 4. Radioactivity in the Rocketdyne reservoir and Bell Creek[a] January–December 1971

Sample description	January-June 1971			July-December 1971		
	Number of samples	Alpha radioactivity	Beta-gamma radioactivity	Number of samples	Alpha radioactivity	Beta-gamma radioactivity
Reservoir (station 6), water [a] (pCi/liter)	6	0.23	6.1	6	0.12	6.2
Reservoir (station 12), water [a] (pCi/liter)	6	.15	6.2	6	.17	6.5
Bell Creek (station 54), mud (pCi/g)	6	.31	23	6	.40	23
Bell Creek (station 54), vegetation (pCi/g ash)	6	.19	161	6	.20	96
Bell Creek (station 16), water (pCi/liter)	6	.21	3.9	6	.10	3.7

[a] Location not shown on figure 1.

Creek Canyon approximately 2.5 miles downstream from the south NDFL boundary. Samples, obtained and analyzed monthly, include stream bed mud, vegetation, and water. Average radioactivity concentrations in the main holding reservoir and Bell Creek samples are presented in table 4.

Soil, vegetation, and water are sampled monthly at Chatsworth Reservoir which is owned and operated by the Los Angeles City Department of Water and Power. Normally, one water sample is obtained from the lake surface and a second sample is obtained from the reservoir water supply inlet located on the north side of the lake. The lake was drained in July 1969 for construction, thereby precluding surface sampling for the current reporting period. The average radioactivity concentration in reservoir supply water samples is presented in table 5.

Soil and vegetation monitoring

Soil and vegetation are regularly sampled at 25 locations. Eleven sampling stations are located within the boundaries of Atomics International's sites and are referred to as "onsite" stations. The remaining 14 stations, located within a 10-mile radius of sites, are referred to as "offsite" stations.

Surface soil types available for sampling range from decomposed granite to clay loam. Samples are taken from the top half-inch layer of undisturbed ground surface. The soil samples are packaged and sealed in plastic containers and returned to the laboratory for analysis. Radioactivity in soil samples is presented in table 6.

Vegetation samples obtained in the field are of the same plant type wherever possible, generally, sunflower or wild tobacco plant leaves.

Table 5. Chatsworth Reservoir water radioactivity, Atomics International January–December 1971

Sample	Type of radioactivity	January-June 1971		July-December 1971	
		Number of samples	Average concentration (pCi/liter)	Number of samples	Average concentration (pCi/liter)
Lake surface	Alpha	0	—	0	—
	Beta-gamma	0	—	0	—
Supply inlet	Alpha	6	0.48	2	0.26
	Beta-gamma	6	6.1	2	6.3

Table 6. Radioactivity in the soil, Atomics International January–December 1971

Area	Type of radioactivity	January-June 1971		July-December 1971	
		Number of samples	Average concentration (pCi/g)	Number of samples	Average concentration (pCi/g)
Onsite	Alpha	72	0.57	72	0.55
	Beta-gamma	72	25	72	25
Offsite	Alpha	24	.55	24	.50
	Beta-gamma	24	24	24	23

These types maintain a more active growth rate during the dry season than do most natural vegetation indigenous to the local area. Vegetation leaves are stripped from plants and transferred to the laboratory for analysis. Plant root systems are not routinely sampled. Radioactivity in vegetation samples is presented in table 7.

External radiation

Site boundary radiation monitoring is performed with calcium fluoride thermoluminescent dosimeters (TLD) placed at selected locations on or near the perimeters of the Headquarters and NDFL sites. Each dosimeter, sealed in a lightproof plastic holder, is installed in a polyethylene vial which is permanently mounted at each monitoring location. The dosimeters are exchanged and analyzed quarterly. The radiation dose monitored at each dosimeter location is presented in table 8.

Recent coverage in *Radiation Data and Reports:*

Period	Issue
January–June 1971	February 1972

Table 8. External radiation dose, Atomics International January–December 1971

Location	January-June 1971		July-December 1971 [a]	
	Dose (mrem)	Average dose rate (μrem/h)	Dose (mrem)	Average dose rate (μrem/h)
TLD-1	97	24	102	44
TLD-2	67	16	80	34
TLD-3	90	22	42	18
TLD-4	99	24	416	179
TLD-5	81	20	42	18
TLD-6	84	21	32	14
TLD-7	99	24	48	21
TLD-8	108	27	51	22
TLD-9	[b] 39	18	35	15
TLD-10	132	32	42	18

[a] Fourth quarter only, TLD reader malfunction resulted in anamolous data.

[b] Second quarter only.

Table 7. Radioactivity in vegetation, Atomics International January–December 1971

Area	Type of radioactivity	January-June 1971		July-December 1971	
		Number of samples	Average (pCi/g-ash)	Number of samples	Average (pCi/g-ash)
Onsite	Alpha	72	0.25	72	0.20
	Beta-gamma	72	165	72	164
Offsite	Alpha	24	.26	24	.34
	Beta-gamma	24	134	24	130

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Reported Nuclear Detonations, July 1973

(Includes seismic signals presumably from foreign nuclear detonations)

Seismic signals, presumably from a Soviet underground nuclear explosion, were recorded by the United States on July 9, 1973. The signals originated at the Semipalatinsk nuclear test area and were equivalent to those of an underground nuclear explosion in the yield range of 20–200 kilotons.

Seismic signals from a Soviet underground nuclear test in the yield range of 200 kilotons to 1 megaton were recorded by the United States on July 22, 1973. The signals originated at about 9:23 p.m., e.d.t. in the Semipalatinsk nuclear test area of the Soviet Union.

There were no reported nuclear detonations for the United States for July 1973.

Not all of the nuclear detonations in the United States are announced immediately, therefore, the information in this section may not be complete. A complete list of announced U.S. nuclear detonations may be obtained upon request from the Division of Public Information, U.S. Atomic Energy Commission, Washington, D.C. 20545.

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SYNOPSES

Synopses of reports, incorporating a list of key words, are furnished below in reference card format for the convenience of readers who may wish to clip them for their files.

THE POTENTIAL EYE EXPOSURE TO PERSONNEL USING FLUOROSCOPIC TECHNIQUES. *H. D. Maillie and W. D. Gregory. Radiation Data and Reports, Vol. 14,* August 1973, pp. 463–466

Measurements were made on a mockup to estimate the weekly exposure to the eyes of personnel working in the vicinity of a fluoroscope used in diagnostic radiology. A radiologist utilizing the image intensifier and protected by means of a lead drape and panel could receive 36 mR/week to the eyes whereas other individuals positioned away from this area, but in the vicinity of the table could receive up to 700 mR/week. The factors associated with these estimates, and the importance of wearing personnel monitors where they will estimate eye exposures are discussed.

Keywords: eye exposure, diagnostic radiology, fluoroscopy

RADIATION DATA AND REPORTS

Volume 14, Number 9, September 1973

Radiation Data and Reports, a monthly publication of the Environmental Protection Agency, presents data and reports provided by Federal, State, and foreign governmental agencies, and other cooperating organizations. Pertinent original data and interpretive manuscripts are invited from investigators.

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. This responsibility was delegated to the Bureau of Radiological Health, Public Health Service. Pursuant to the Reorganization Plan No. 3 of 1970, effective December 2, 1970, this responsibility was transferred to the Radiation Office of the Environmental Protection Agency which was established by this reorganization.

The Federal agencies listed below appoint their representatives to a Board of Editorial Advisors. Members of the Board advise on general publications policy; secure appropriate data and manuscripts from their agencies; and review those contents which relate to the special functions of their agencies.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
Russell E. Train, Administrator

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Environmental Monitoring and Disposal of Radioactive Wastes from U.S. Naval Nuclear-Powered Ships and Their Support Facilities, 1972

M. E. Miles and G. L. Sjoblom[1]

The environmental effect of disposal of radioactive wastes originating from U.S. Naval nuclear propulsion plants and their support facilities is assessed. The total radioactivity discharged to all ports and harbors from the more than 100 nuclear-powered ships and supporting tenders, bases and shipyards was less than 0.002 curie in 1972. This report confirms that procedures used by the Navy to control releases of radioactivity from U.S. Naval nuclear-powered ships and their support facilities are effective in protecting the environment and the health and safety of the general public.

The radioactivity in wastes discussed in this report originates in the pressurized water reactors of U.S. Naval nuclear-powered ships. As of the end of 1972, there were 100 nuclear-powered submarines and 4 nuclear-powered surface ships in operation. Support facilities involved in construction, maintenance, overhaul and refueling of these nuclear propulsion plants include 9 shipyards, 11 tenders, and 2 submarine bases. This report describes disposal of radioactive liquid wastes, disposal of solid wastes and monitoring of the environment to determine the effect of radioactive releases. This report concludes that radioactivity associated with U.S. Naval nuclear-powered ships has had no significant or discernible effect on the quality of the human environment. A summary of radiological environmental information supporting this conclusion follows.

From the start of the Naval nuclear propulsion program, the policy of the U.S. Navy has been to reduce to the minimum practicable the amounts of radioactivity released into harbors. Navy procedures to accomplish this have been reviewed with the U.S. Atomic Energy Commission (AEC) and the U.S. Environmental Protection Agency (EPA). The total radioactivity discharged within 12 miles from shore from all U.S. Naval nuclear-powered ships and their support facilities in recent years is shown in table 1.

As a measure of the significance of these data, if one person were able to drink the entire amount of radioactivity discharged into any harbor in 1972, he would not exceed the annual individual radiation exposure permitted by the U.S. Atomic Energy Commission for its employees and licensees.

Table 1. Total radioactivity discharged within 12 miles from shore from all U.S. Naval nuclear-powered ships and their support facilities, 1968–1972

Year	Number of ships in operation	Volume (1,000 gallons)	Radioactivity less tritium (curies)
1968	84	3,691	0.081
1969	91	3,326	.048
1970	96	2,571	.024
1971	100	1,089	<.002
1972	104	289	<.002

Extensive environmental monitoring is conducted by the Navy in the United States and foreign harbors frequented by nuclear-powered ships. This monitoring consists of collecting and analyzing harbor water and sediment samples for radioactivity associated with Naval nuclear propulsion plants, radiation monitoring around the perimeter of support facilities and effluent monitoring. The EPA has conducted independent surveys, the results of which have been consistent with Navy results. These surveys have confirmed that U.S. Naval nuclear-powered ships and support facilities have had no significant effect on the radioactivity of the marine environment.

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[1] Nuclear Power Directorate, Naval Ship Systems Command, Department of the Navy.

Radioactive liquid waste disposal

Policy and procedures minimizing release of radioactivity in harbors

The policy of the U.S. Navy is to reduce to the minimum practicable the amounts of radioactivity released within 12 miles from shore including into harbors. This policy is consistent with applicable recommendations issued by the Federal Radiation Council (incorporated into the Environmental Protection Agency late in 1970), U.S. Atomic Energy Commission, National Council on Radiation Protection and Measurements, International Commission on Radiological Protection (ICRP), International Atomic Energy Agency, and National Academy of Sciences—National Research Council (*1-7*). Keeping releases small minimizes the radioactivity available to build up in the environment or to concentrate in marine life. To implement this policy of minimizing releases, the Navy has issued standard instructions defining the radioactive waste disposal limits and procedures to be used by U.S. Naval nuclear-powered ships and their support facilities. These instructions were reviewed and concurred in by the AEC and the Public Health Service (PHS). The radiological surveillance organization of PHS has since been moved to the EPA.

Source of radioactivity

In the shipboard reactors, pressurized water circulating through the reactor core picks up the heat of nuclear reaction. Reactor cooling water circulates through a closed piping system to heat exchangers which transfer the heat to water in a secondary steam system isolated from the primary cooling water. The steam is then used as the source of power for the propulsion plant as well as for auxiliary machinery. Releases from ships occur primarily when reactor coolant water expands as a result of being heated to operating temperature; this coolant passes through a purification sys-

Table 2. Radioactive liquid waste released to harbors from U.S. Naval nuclear-powered ships and their support facilities for 1968 through 1972[a]

Facility	1968		1969		1970		1971		1972	
	(Volume Thousand gallons)	(Radioactivity Curies)	(Volume Thousand gallons)	(Radioactivity Curies)	(Volume Thousand gallons)	(Radioactivity Curies)	(Volume Thousand gallons)	(Radioactivity Curies)	(Volume Thousand gallons)	(Radioactivity Curies)
Portsmouth, N.H.; Naval Shipyard	171	0.006	87	0.002	68	0.002	51	<0.001	25	<0.001
Groton-New London, Conn; Electric Boat Division, Tender at State Pier and Sub Base	469	.006	615	.006	359	.004	258	<.001	151	<.001
Newport News, Va; Newport News Shipbuilding	1,146	.025	870	.022	1,466	.013	262	<.001	13	<.001
Norfolk, Va; Naval Shipyard and Tender	184	.004	102	.005	98	.001	38	<.001	18	<.001
Charleston, S.C.; Naval Shipyard and Tenders	227	.004	131	.001	58	<.001	45	<.001	8	<.001
Pascagoula, Miss; Ingalls Nuclear Division	9	<.001	8	<.001	7	<.001	28	<.001	12	<.001
San Diego, Calif; Tenders at Ballast Point	<1	<.001	<1	<.001	<1	<.001	<1	<.001	<1	<.001
Long Beach, Calif; Naval Shipyard and Base	<1	<.001	2	<.001	<1	<.001	<1	<.001	<1	<.001
Vallejo, Calif; Mare Island Naval Shipyard	391	.027	80	.001	121	.002	219	<.001	7	<.001
Bremerton, Wash; Puget Sound Naval Shipyard	182	.001	152	.001	136	<.001	98	<.001	16	<.001
Pearl Harbor, Hawaii, Naval Shipyard and Sub Base	886	.006	1,279	.008	258	.002	90	<.001	38	<.001
Apra Harbor, Guam	26	.001	<1	<.001	<1	<.001	<1	<.001	<1	<.001
All other harbors, United States and foreign	<1	<.001	<1	<.001	<1	<.001	<1	<.001	<1	<.001
Total	3,691	0.081	3,326	0.048	2,571	0.024	1,089	<0.002	289	<0.002

[a] Radioactivity data have been standardized to cobalt-60 and excludes tritium. Volumes are prior to dilution. A total of 0.02 curie was discharged into the river at Quincy, Mass. from 1961 through March 1969 when all work on U.S. Naval nuclear-powered ships was discontinued at General Dynamics, Quincy Division. Slight differences in volumes and radioactivity data from past reports result from using more significant figures in this table. Volumes less than 500 gallons are shown as <1 thousand. Curies less than 0.0005 are shown as <0.001.

tem ion exchange resin bed prior to being transferred from the ship.

The principal source of radioactivity in liquid wastes is from neutron activation of trace amounts of corrosion and wear products from reactor plant metal surfaces in contact with half-lives greater than 1 day in these corrosion and wear products include tungsten-187, chromium-51, hafnium-181, iron-59, iron-55, zirconium-95, tantalum-182, manganese-54, cobalt-58, and cobalt-60. The predominant and also longest-lived of these is cobalt-60, which has a 5.3 year half-life; cobalt-60 also has the most restrictive concentration limit in water listed by organizations which set radiological standards in references *1-3* for these corrosion and wear radionuclides. Therefore, radioactive waste disposal is conservatively controlled by assuming that all long-lived radioactivity is cobalt-60.

Support facilities are equipped with processing systems to remove most of the radioactivity from liquid waste prior to release into harbors. These liquid wastes result from transferring water from ships as well as decontaminating radioactively contaminated piping systems and laundering anticontamination clothing worn by personnel.

Liquid waste releases in harbors

The total amounts of long-lived radioactivity released into harbors and seas within 12 miles from shore during the past 5 years are summarized in table 2, which updates information in references *8-14*. Included are data on releases from U.S. Naval nuclear-powered ships and from supporting shipyards, tenders, and submarine bases. Locations listed in table 2 include all operating bases and home ports in the United States and overseas as well as all other ports which have been visited by Naval nuclear-powered ships. The quantities of radioactivity listed in this table are conservatively reported as if the entire radioactivity consisted of cobalt-60, which is the predominant long-lived radionuclide and also has the most stringent concentration limits.

Although this table shows both volume and curies released, the curie data are the more significant. In 1972, the volumes shown in table 2 for these organizations were no more than many single United States homes release to their sewage systems each year. The volume released has been reduced over several years by reducing waste generation as well as reuse of liquids after processing.

Table 3. Total radioactive liquid waste released at sea by all U.S. Naval nuclear-powered ships and supporting tenders

Year	Volume (thousand gallons)	Radioactivity (Ci)
1968	1,630	1.1
1969	1,570	1.7
1970	1,220	.8
1971	1,840	.8
1972	1,970	.6

The table shows that the total amount of radioactivity released within all United States and foreign harbors by the more than 100 nuclear-powered ships in the U.S. Navy was less than 0.002 curie. Nearly all the radioactive releases occur where shipyards are overhauling nuclear-powered ships. To put this small quantity of radioactivity into perspective, it is less than the quantity of naturally occurring radioactivity (*15*) in the volume of saline harbor water occupied by a single nuclear-powered submarine. This small amount of radioactivity has had no significant or discernible effect on the quality of the human environment.

Other radionuclides

Reactor coolant also contains short-lived radionuclides with half-lives of seconds to hours. Their highest concentrations in reactor coolant are from nitrogen-16 (7 second half-life), nitrogen-13 (10 minute half-life), fluoride-18 (1.8 hour half-life), argon-41 (1.8 hour half-life) and manganese-56 (2.6 hour half-life). For the longest-lived of these, about 1 day after discharge from an operating reactor the concentration is reduced to one thousandth of the initial concentration and in about 2 days the concentration is reduced to one millionth. Most liquid releases from ships occur during heating up prior to extensive power operation of the reactor, when short-lived radioactivity in such a release is less than 0.001 curie. Because of their small amounts and rapid decay, short-lived radionuclides are insignificant compared to long-lived radionuclides for waste disposal considerations.

Fission products produced in the reactor are retained within the fuel elements. The fission gases, krypton and xenon, are also retained within the fuel elements. However, trace quantities of naturally occurring uranium impurities in reactor structural materials release small amounts of fission products to reactor coolant. The concentrations of fission products and the volumes of reactor coolant released are so low, however, that the total radioactivity attributed to long-lived fission product radionuclides, strontium-90 and cesium-137, in releases from U.S. Naval nuclear-powered ships and their support facilities has been less than 0.001 curie per year for all harbors combined. Fallout of these same fission products has often been more than this in one rainfall in a single harbor.

Tritium

Small amounts of tritium are formed in reactor coolant systems as a result of neutron interaction with the approximately 0.015 percent of naturally occurring deuterium present in water, and other nuclear reactions. Although tritium has a 12-year half-life, the radiation produced is of such low energy that the radioactivity concentration guide issued by the ICRP, AEC, and by other standard-setting organizations is 100 times higher for tritium than for cobalt-60. This tritium is in the oxide form and chemically indistinguishable from water; therefore it does not concentrate significantly in marine life or collect on sediment as do other radionuclides.

Tritium is naturally present in the environment because it is generated by cosmic radiation in the upper atmosphere. Reference *16* reports that the production rate from this source is about 6 million curies per year, which through rainfall produces a tritium inventory in the oceans of about one hundred million curies. Because of this naturally occurring tritium, much larger releases of tritium than are conceivable from Naval reactors would be required to make a measurable change in the background tritium concentration.

The total amount of tritium released during each of the last 5 years from all U.S. Naval nuclear-powered ships and their supporting tenders, bases and shipyards has been less than 200 curies. Most of this has been into the ocean greater than 12 miles from shore. This total tritium from the entire nuclear Navy is less than typical electrical generating nuclear power stations release each year (*17*). Such releases are too small to increase measurably the tritium concentration in the environment. Therefore, tritium has been excluded from the data in other sections of this report.

Liquid waste releases at sea

Radioactive liquid wastes are also released at sea under strict controls. These ocean releases are consistent with the recommendations the Council on Environmental Quality made in 1970 to the President (*18*). Procedures and limits for ocean disposal have been consistent with recommendations made by the National Academy of Sciences—National Research Council (*5*) and by the International Atomic Energy Agency (*6*).These releases have contained much less radioactivity than these reports considered would be acceptable. Total long-lived radioactivity excluding tritium, released farther than 12 miles from shore by U.S. Naval nuclear-powered ships and supporting tenders is shown in table 3 for recent years. This is the total amount released from over 100 ships at different times of the year in the open sea at long distances from land in small incremental amounts, and under rapid dispersal conditions due to wave action. Therefore, the radioactivity reported in table 3 has no significant effect on the radioactivity of the marine environment.

Solid radioactive waste disposal

During maintenance and overhaul operations, solid low-level radioactive wastes consisting of contaminated rags, plastic bags, paper, filters, ion exchange resin and scrap materials are collected by nuclear-powered ships and their support facilities. High-level radioactive wastes are associated with expended reactor fuel all of which is transferred to the AEC for processing ashore.

Solid radioactive materials from Naval nuclear-powered ships are not dumped at sea

Table 4. Radioactive solid waste from U.S. Naval nuclear-powered ships and their support facilities for 1968 through 1972[a]

Facility	1968		1969		1970		1971		1972	
	Volume (thousand cubic feet)	Radioactivity (curies)	Volume (thousand cubic feet)	Radioactivity (curies)	Volume (thousand cubic feet)	Radioactivity (curies)	Volume (thousand cubic feet)	Radioactivity (curies)	Volume (thousand cubic feet)	Radioactivity (curies)
Portsmouth, N.H; Naval Shipyard	31	151	8	3	14	16	12	9	9	4
Groton, New London, Conn; Electric Boat Div., Tender at State Pier and Sub Base	4	21	8	328	12	140	18	13	7	6
Newport News, Va; Newport News Shipbuilding	14	10	17	382	28	312	21	165	10	8
Norfolk, Va; Naval Shipyard and Tender	2	11	6	8	9	146	10	33	10	1,026
Charleston, S.C; Naval Shipyard and Tenders	14	110	15	9	8	6	6	4	[illegible]	34
Pascagoula, Miss; Ingalls Nuclear Division	0	0	1	<1	0	0	2	<1	2	2
San Diego, Calif; Tenders at Ballast Point	1	8	<1	2	<1	1	2	<1	<1	<1
Long Beach, Calif; Naval Shipyard and Base	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Vallejo, Calif; Mare Island Naval Shipyard	8	7	8	5	12	2	22	25	9	13
Bremerton, Wash; Puget Sound Naval Shipyard	14	48	11	42	18	1,327	21	59	9	22
Pearl Harbor, Hawaii; Naval Shipyard and Sub Base	3	6	4	3	5	4	4	2	4	147
Total	92	372	78	783	106	1,954	119	311	67	1,262

[a] This table includes all radioactive waste from tenders and nuclear-powered ships. This radioactivity is primarily cobalt-60. This radioactive waste is shipped to burial facilities licensed by the USAEC or State. Slight differences from past reports result from using different number of significant figures in this table. Volumes less than 500 cubic feet are reported as <1 thousand and less than 0.5 curie is reported as <1 curie.

since the Navy procedures prohibit sea disposal of solid radioactive materials. Solid radioactive waste materials are packaged in strong tight containers, shielded as necessary and shipped to burial sites licensed by the AEC or a State under agreement with the AEC. Shipyards and other shore facilities are not permitted to dispose of radioactive solid wastes by burial on their own sites. The Navy procedures require all packaging and shipping of radioactive materials to be performed in strict compliance with U.S. Department of Transportation and AEC requirements.

Table 4 summarizes total radioactivity and volumes of radioactive solid waste disposal for the last 5 years. Table 4 does not include expended fuel which is processed by the AEC at special facilities ashore.

Because of efforts to minimize solid waste and the utilization of compaction equipment, total volumes have remained nearly constant in spite of increasing work caused by increasing number of ships. The average annual volume for the entire Naval nuclear propulsion program could be contained in a cube measuring 15 yards on a side. The radioactivity does not require excessively long time care in the licensed burial ground since the principal radionuclides do not have half-lives longer than 5 years. In 100 years, such radioactivity will have decayed to one millionth the initial radioactivity. In less than 200 years, the total of all radioactivity conservatively assumed to be cobalt-60 in table 4 will have decayed to less than one millionth of a curie and would not be detectable in the burial grounds using sensitive instruments.

Environmental monitoring

To provide additional assurance that procedures used by the U.S. Navy to control radioactivity are adequate to protect the environment, the Navy conducts an extensive environmental monitoring program in harbors frequented by nuclear-powered ships. Environmental monitoring surveys for radioactivity are periodically performed in harbors where U.S. Naval nuclear-powered ships are built or overhauled and where these ships have home ports or operating bases. To ensure thoroughness and objectivity, these surveys are made as independent as practicable from waste disposal operations. Samples from each harbor monitored are also checked at least annually by an AEC laboratory to ensure that analytical procedures are correct and standardized. These AEC laboratory results have been consistent with shipyard and operating base results. As a further independent check of environmental monitoring, a laboratory of the Environmental Protection Agency (formerly part of U.S. Public Health Service) has conducted detailed surveys of selected harbors (*19-21*). This laboratory has monitored the harbors at Charleston, S.C; Pearl Harbor, Hawaii; San Diego, Calif; Vallejo, Calif; New London, Conn; Newport

News, Va; and Norfolk, Va. Navy monitoring results have been consistent with these survey results.

The current Navy environmental monitoring program consists of the analysis of samples of harbor water and sediment, supplemented by shoreline surveys, film badge analysis and effluent monitoring.

Five water samples are taken in each harbor once each quarter year in areas where nuclear-powered ships berth and from upstream and downstream locations. These samples are analyzed for gross gamma radioactivity and for cobalt-60 content. Procedures for analysis will detect cobalt-60 if its concentration exceeds one three hundredths of the AEC limit (*1*). No cobalt-60 has been detected in any of the 3,460 water samples from all harbors monitored.

A radiological laboratory now part of the Environmental Protection Agency analyzed samples from harbors to identify radionuclides present in sediment. These analyses showed cobalt-60 was the predominant radionuclide added to sediment from Naval nuclear reactor operations. Therefore, Navy monitoring procedures require collecting 20 to 120 sediment samples in each harbor once each quarter year. Standard 6-inch square samplers modified to collect only the top one-half to one inch of sediment are used. The top layer was selected because it should be more mobile and more accessible to marine life than deeper layers. The samples are analyzed for gross gamma radioactivity and for cobalt-60. Results of the 3,146 sediment samples from harbors monitored by the Navy in the United States and possessions for 1972 are summarized in table 5.

Evaluation of the data summarized in table 5 shows that low-level cobalt-60 radioactivity in harbor bottom sediment is detected around a few piers at operating bases and shipyards where nuclear-powered ship maintenance and overhauls have been conducted over a period of several years. Cobalt-60 is not detectable above background levels in general harbor bottom areas away from these piers. Maximum total radioactivity observed in a U.S. harbor is less than 1 curie of cobalt-60. This radioactivity is small compared to background, since the quantity of naturally occurring radioactivity such as potassium-40, radium, uranium and thorium present in the sediment of a typical harbor amounts to hundreds of curies. Comparison to previous environmental monitoring data in references *8* through *14* shows that these environmental cobalt-60 levels have been steadily decreasing.

The first data column in table 5 includes all samples with less than 3 picocuries of cobalt-60 per gram of sediment. These low levels are difficult to measure because the levels of radioactivity in sediment from other sources are much higher. The value of 30 picocuries per gram was selected for the top of the second

Table 5. Summary of 1972 surveys for cobalt-60 in bottom sediment of U.S. harbors where U.S. Naval nuclear-powered ships have been regularly based, overhauled or built

Facility	Number of samples with cobalt-60			Total bottom area with cobalt-60 over 3 pCi/g[c] (km²)	Estimated total cobalt-60 in top layer of sediment[d] (Ci)
	<3 (pCi/g)[a]	3-30 (pCi/g)	>30-300 (pCi/g)[b]		
Portsmouth, N.H; Naval Shipyard	176	0	0	0	ND
Groton, New London, Conn; Electric Boat Division, State Pier and Submarine Base	461	40	2	0.1	0.02
Newport News, Va; Newport News Shipbuilding	152	0	0	0	ND
Norfolk, Va; Naval Shipyard and Base	344	0	0	0	ND
Charleston, S.C; Naval Shipyard and Bases	384	0	0	0	ND
Pascagoula, Miss; Ingalls Nuclear Division	216	0	0	0	ND
San Diego, Calif; Navy Piers at Ballast Point	160	0	0	0	ND
Long Beach, Calif; Naval Shipyard and Base	160	0	0	0	ND
Vallejo, Calif; Mare Island Naval Shipyard	397	0	0	0	ND
Bremerton, Wash; Puget Sound Naval Shipyard	156	0	0	0	ND
Pearl Harbor, Hawaii; Naval Shipyard and Sub Base	351	1	0	0.001	ND
Apra Harbor, Guam	101	0	0	0	ND
Port Canaveral, Fla	42	0	0	0	ND

[a] Minimum detectable radioactivity is approximately 1 pCi/g wet weight (picocurie per gram). Results in units of pCi/cm² range from two to four times the value of pCi/g.

[b] Maximum radioactivity in these samples was 59 pCi/g.

[c] One square kilometer is approximately equal to 0.4 square mile. Areas with cobalt-60 over 3 pCi/g were in immediate vicinity of piers used for berthing nuclear-powered ships.

[d] Where total cobalt-60 in the surface sediment layer is less than 0.01 curie, ND is reported. Samples more than 1 foot deep from several harbors show that total cobalt-60 present may be two to five times that measured in the surface layer.

range of data since it corresponds to the upper limit for exposure in references *1* and *3* even if consumed continuously by members of the general public. Although sediment cannot be consumed by humans, it might serve as a food source for marine life. Data on uptake of cobalt-60 from sediment by marine life obtained to date show that in the salt water harbor bottom environments, no significant buildup of cobalt-60 occurs in marine life. Such buildup is unlikely because the cobalt is in the form of insoluble metallic oxides. Therefore the third range of up to 300 picocuries per gram is selected as a range which would not cause members of the general public to receive radiation exposure approaching the values set in references *1-4*. Concentrations of cobalt-60 up to 300 picocuries per gram are so low that the AEC does not require those who might possess them to be licensed. If concentrations higher than 300 picocuries per gram were to persist over substantial areas of a harbor bottom, further monitoring would be performed to determine if any of this radioactivity were being taken up by marine life for eventual consumption in food. Because of the low concentrations noted in table 5, monitoring of radioactivity in marine life has not been necessary as part of the routine environmental monitoring programs in these harbors.

Estimates of the radiation exposure to members of the general public from radioactivity released into river and harbor waters and sediment and in air exhausted from facilities have been made as discussed in references *15* and *22*, by analyzing the pathways whereby radioactivity might be transmitted from the marine environment to man. These analyses considered direct exposure, such as to sediment along shorelines and by drinking harbor water, and indirect pathways such as consumption of bottom feeding fish or shellfish. These analyses showed that personnel exposure from this radioactivity would be far too low to measure and could only be estimated. Based on radioactivity released including the amounts and concentrations reported in table 2 of this report, the maximum radiation exposure in a year to any member of the general public would be less than 0.01 millirem. This is less than one ten thousandth of the average annual exposure of 125 millirem (*7*) to members of the general public from natural radioactivity or from exposure to medical diagnostic x rays. Thus the radioactivity released from the Naval nuclear propulsion program has not caused significant radiation exposure to the general public.

For comparison, references *23* and *24* contain evaluations by AEC laboratories of the effects on the environment from the accumulation near points of discharge of radionuclides from several nuclear reactors. These reports conclude for these other reactors that radioactivity levels much greater than shown in table 5 have caused no significant radiation exposure to the general public.

In all monitored harbors, shoreline areas uncovered at low tide are surveyed twice per year for radiation levels with sensitive radiation detectors to determine if any radioactivity from bottom sediment washed ashore. All results were the same as background radiation levels in these regions, approximately 0.01 millirem per hour. Thus there is no evidence in these ports that radioactivity from sediment is washing ashore.

Film badges are continuously posted at locations outside the boundaries of areas where radioactive work is performed. These films showed that radiation exposure to the general public outside these facilities was not above that received from natural background radiation levels.

Naval nuclear reactors and their support facilities are designed to ensure there are no significant discharges of radioactivity in airborne exhausts. Radiological controls are exercised in support facilities to preclude exposure of working personnel to airborne radioactivity exceeding limits such as specified in reference *1*. Further, all air exhausted from these facilities is passed through high efficiency particulate air filters and monitored during discharge. There were no discharges of airborne radioactivity above concentrations normally present in the atmosphere.

Conclusions

The total radioactivity discharged into all

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ports and harbors from the U.S. Naval nuclear propulsion program was less than 0.002 curie in 1972.

No increase of radioactivity above normal background levels has been detected in harbor water where U.S. Naval nuclear-powered ships are based, overhauled, or constructed.

Liquid wastes from U.S. Naval nuclear-powered ships and support facilities have not caused a measurable increase in the general background radioactivity of the environment.

Low-level cobalt-60 radioactivity in harbor bottom sediment is detectable around a few piers at operating bases and shipyards where nuclear-powered ship maintenance and overhauls have been conducted over a period of several years. Cobalt-60 is not detectable above background levels in general harbor bottom areas away from these piers. Maximum total radioactivity observed in a U.S. harbor of less than one curie of cobalt-60 is small compared to the naturally occurring radioactivity. Comparison to previous environmental data summarized in references *8* through *14* show that these environmental cobalt-60 levels are continuing to decrease.

Procedures used by the Navy to control discharges of radioactivity from U.S. Naval nuclear-powered ships and their support facilities have been effective in protecting the environment and the health and safety of the general public.

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Data

SECTION I. MILK AND FOOD

Milk Surveillance, May 1973

Although milk is only one of the sources of dietary intake of environmental radioactivity, it is the food item that is most useful as an indicator of the general population's intake of radionuclide contaminants resulting from environmental releases. Fresh milk is consumed by a large segment of the population and contains several of the biologically important radionuclides that may be released to the environment from nuclear activities. In addition, milk is produced and consumed on a regular basis, is convenient to handle and analyze, and samples representative of general population consumption can be readily obtained. Therefore, milk sampling networks have been found to be an effective mechanism for obtaining information on current radionuclide concentrations and long-term trends. From such information, public health agencies can determine the need for further investigation or corrective public health action.

The Pasteurized Milk Network (PMN) sponsored by the Office of Radiation Programs, Environmental Protection Agency, and the Office of Food Sanitation, Food and Drug Administration, Public Health Service, consists of 63 sampling stations: 61 located in the United States, one in Puerto Rico, and one in the Canal Zone. Many of the State health departments also conduct local milk surveillance programs which provide more comprehensive coverage within the individual State. Data from 16 of these State networks are reported routinely in *Radiation Data and Reports*. Additional networks for the routine surveillance of radioactivity in milk in the Western Hemisphere and their sponsoring organizations are:

> Pan American Milk Sampling Program (Pan American Health Organization and U.S. Environmental Protection Agency)—5 sampling stations
>
> Canadian Milk Network (Radiation Protection Division, Canadian Department of National Health and Welfare)—16 sampling stations.

The sampling locations that make up the networks presently reporting in *Radiation Data and Reports* are shown in figure 1. Based on the similar purpose for these sampling activities, the present format integrates the complementary data that are routinely obtained by these several milk networks.

Radionuclide and element coverage

Considerable experience has established that relatively few of the many radionuclides that are formed as a result of nuclear fission become incorporated in milk (*1*). Most of the possible radiocontaminants are eliminated by the selective metabolism of the cow, which restricts gastrointestinal uptake and secretion into the milk. The five fission-product radionuclides which commonly occur in milk are strontium-89, strontium-90, iodine-131, cesium-137, and barium-140. A sixth radionuclide, potassium-40, occurs naturally in 0.0118 percent (*2*) abundance of the element potassium, resulting in a specific activity for potassium-40 of 830 pCi/g total potassium.

Two stable elements which are found in milk, calcium and potassium, have been used as a means for assessing the biological behavior of metabolically similar radionuclides (radio-

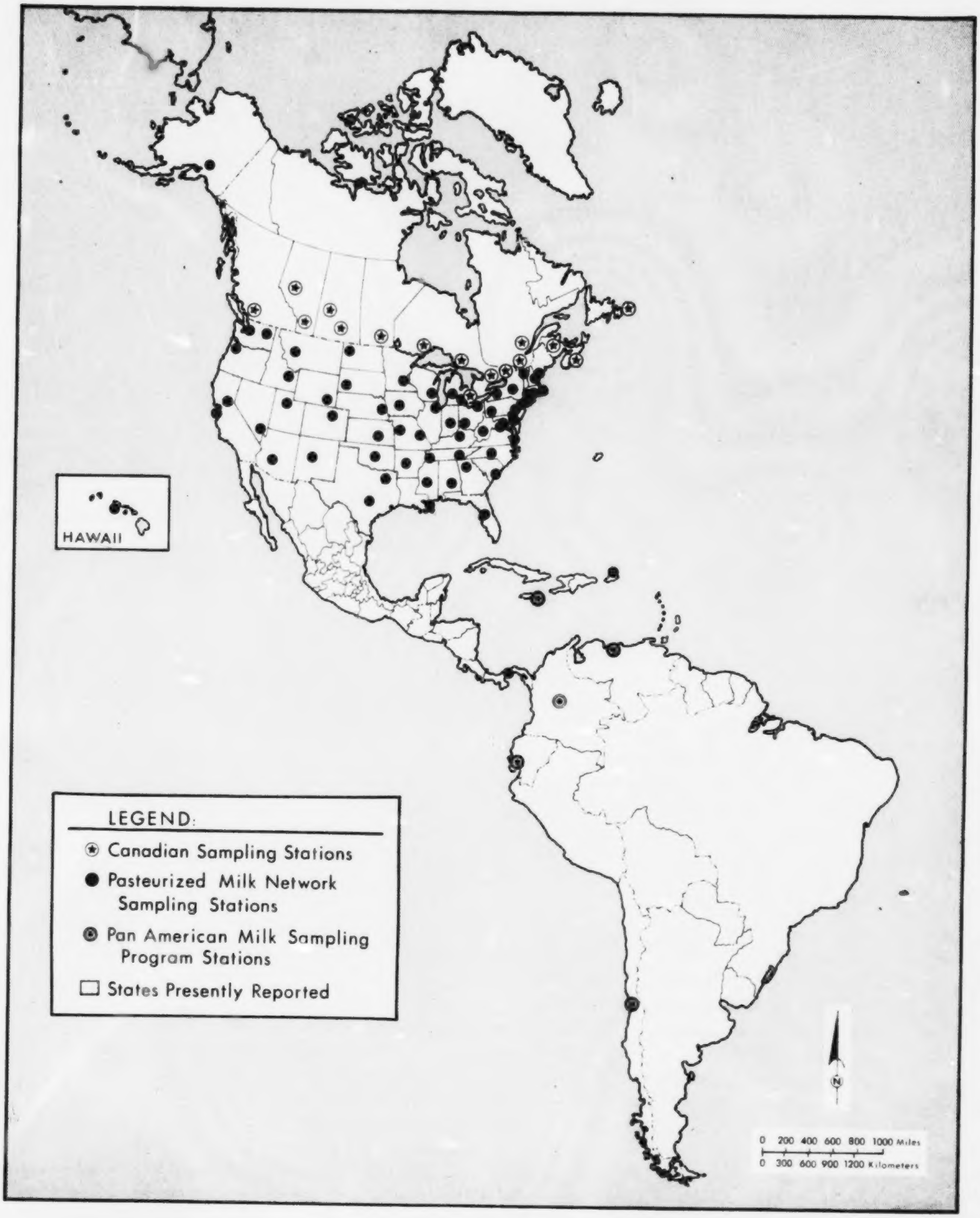
HAWAII
LEGEND:
Canadian Sampling Stations
Pasteurized Milk Network Sampling Stations
Pan American Milk Sampling Program Stations
States Presently Reported
N
0 200 400 600 800 1000 Miles
0 300 600 900 1200 Kilometers

Figure 1. Milk sampling networks in the Western Hemisphere

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strontium and radiocesium, respectively). The contents of both calcium and potassium in milk have been measured extensively and are relatively constant. Appropriate values and their variations, expressed in terms of 2 standard deviations (2σ), for these elements are 1.16 ± 0.08 g/liter for calcium and 1.51 ± 0.21 g/liter for potassium. These figures are averages of data from the PMN for May 1963–March 1966 (*3*) and are used for general radiation calculations.

Accuracy of data from various milk networks

In order to combine data from the international, national, and State networks considered in this report, it was first necessary to determine the accuracy with which each laboratory is making its determinations and the agreement of the measurements among the laboratories. The Analytical Quality Control Service of the Office of Radiation Programs conducts periodic studies to assess the accuracy of determinations of radionuclides in milk performed by interested radiochemical laboratories. The generalized procedure for making such a study has been outlined previously (*4*).

The most recent study was conducted during June 1972 with 37 laboratories participating in an experiment on a milk sample containing known concentrations of iodine-131, cesium-137, strontium-89, and strontium-90 (*5*). Of the 18 laboratories producing data for the network reports in *Radiation Data and Reports*, 14 participated in the study.

The accuracy results of this study for these 14 laboratories are shown in table 1. The accuracy of the cesium-137 measurements continues to be excellent as in previous experiments. However, both the accuracy and precision need to be improved for iodine-131, strontium-89, and strontium-90 which could probably be accomplished through recalibration.

Development of a common reporting basis

Since the various networks collect and analyze samples differently, a complete understanding of several parameters is useful for interpreting the data. Therefore, the various milk surveillance networks that report regularly were surveyed for information on analytical methods, sampling and analysis frequencies, and estimated analytical errors associated with the data.

In general, radiostrontium is collected by an ion-exchange technique and determined by beta-particle counting in low-background detectors, and the gamma-ray emitters (potassium-40, iodine-131, cesium-137, and barium-140) are determined by gamma-ray spectroscopy of whole milk. Each laboratory has its own modifications and refinements of these basic methodologies.

Many networks collect and analyze samples on a monthly basis. Some collect samples more frequently but composite the several samples for one analysis, while others carry out their analyses more often than once a month. Many networks are analyzing composite samples on a quarterly basis for certain nuclides. The fre-

Table 1. Distribution of mean results, quality control experiment

Radionuclide and known concentration	Number of laboratories in each category				Experimental 2σ error (pCi/liter)
	Acceptable[a]	Warning level[b]	Unacceptable[c]	Total	
Iodine-131: (96 or 99 pCi/liter)	7 (58%)	1 (8%)	4 (33%)	12	6
(438 or 484 pCi/liter)	11 (85%)	0	2 (15%)	13	25 or 28
Cesium-137: (53 or 54 pCi/liter)	11 (92%)	0	1 (8%)	12	6
(295 or 303 pCi/liter)	11 (85%)	2 (15%)	0	13	17
Strontium-89: (29 or 30 pCi/liter)	9 (82%)	0	2 (18%)	11	6
(197 or 201 pCi/liter)	3 (33%)	1 (11%)	5 (56%)	9	11 or 12
Strontium-90: (32.1 or 32.4 pCi/liter)	4 (33%)	4 (33%)	4 (33%)	12	1.9
(150.5 or 151.2 pCi/liter)	6 (55%)	0	5 (45%)	11	8.7

[a] Measured concentration equal to or within 2σ of the known concentration.
[b] Measured concentration outside 2σ and equal to or within 3σ of the known concentration
[c] Measured concentration outside 3σ of the known concentration.

quency of collection and analysis varies not only among the networks but also at different stations within some of the networks. In addition, the frequency of collection and analysis is a function of current environmental levels. The number of samples analyzed at a particular sampling station under current conditions is reflected in the data presentation. Current levels for strontium-90 and cesium-137 are relatively stable over short periods of time, and sampling frequency is not critical. For the short-lived radionuclides, particularly iodine-131, the frequency of analysis is critical and is generally increased at the first measurement or recognition of a new influx of this radionuclide.

The data in table 2 show whether raw or pasteurized milk was collected. An analysis (*6*) of raw and pasteurized milk samples collected during January 1964 to June 1966 indicated that for relatively similar milkshed or sampling areas, the differences in concentration of radionuclides in raw and pasteurized milk are not statistically significant (*6*). Particular attention was paid to strontium-90 and cesium-137 in that analysis.

Practical reporting levels were developed by the participating networks, most often based on 2-standard-deviation counting errors or 2-standard-deviation total analytical errors from replicate analyses (*3*). The practical reporting level reflects analytical factors other than statistical radioactivity counting variations and will be used as a practical basis for reporting data.

The following practical reporting levels have been selected for use by all networks whose practical reporting levels were given as equal to or less than the given value.

Radionuclide	Practical reporting level (pCi/liter)
Strontium-89	5
Strontium-90	2
Iodine-131	10
Cesium-137	10
Barium-140	10

Some of the networks gave practical reporting levels greater than those above. In these cases the larger value is used so that only data considered by the network as meaningful will be presented. The practical reporting levels apply to the handling of individual sample determinations. The treatment of measurements equal to or below these practical reporting levels for calculation purposes, particularly in calculating monthly averages, is discussed in the data presentation.

Analytical error or precision expressed as pCi/liter or percent in a given concentration range has also been reported by the networks (*3*). The precision errors reported for each of the radionuclides fall in the following ranges:

Radionuclide	Analytical errors of precision (2 standard deviations)
Strontium-89	1–5 pCi/liter for levels <50 pCi/liter; 5–10% for levels $\geqq 50$ pCi/liter;
Strontium-90	1–2 pCi/liter for levels <20 pCi/liter; 4–10% for levels $\geqq 20$ pCi/liter;
Iodine-131 Cesium-137 Barium-140	4–10% pCi/liter for levels <100 pCi/liter; 4–10% for levels $\geqq 100$ pCi/liter.

For iodine-131, cesium-137, and barium-140, there is one exception for these precision error ranges: 25 pCi/liter at levels <100 pCi/liter for Colorado. This is reflected in the practical reporting level for the Colorado milk network.

Federal Radiation Council guidance applicable to milk surveillance

In order to place the U.S. data on radioactivity in milk presented in *Radiation Data and Reports* in perspective, a summary of the guidance provided by the Federal Radiation Council for specific environmental conditions was presented in the February 1973 issue of *Radiation Data and Reports.*

Data reporting format

Table 2 presents the integrated results of the international, national, and State networks discussed earlier. Column 1 lists all the stations which are routinely reported in *Radiation Data and Reports.* The relationship between the PMN stations and the State stations is shown

Table 2. Concentrations of radionuclides in milk for May 1973 and 12-month period, June 1972 through May 1973

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:						
Ala:	Montgomery [e]	P	NA	5	0	4
Alaska:	Palmer [e]	P	2	4	0	2
Ariz:	Phoenix [e]	P	NA	0	0	0
Ark:	Little Rock [e]	P	9	9	0	3
Calif:	Sacramento [e]	P	NA	1	0	0
	San Francisco [e]	P	NA	0	0	0
	Del Norte	P	12	11	0	7
	Fresno	P	0	1	0	2
	Humboldt	P	3	3	0	2
	Los Angeles	P	0	1	0	2
	Mendocino	P	3	2	0	4
	Sacramento	P	2	2	0	3
	San Diego	P	0	1	0	3
	Santa Clara	P	0	2	0	2
	Shasta	P	2	2	0	5
	Sonoma	P	2	2	0	3
Colo:	Denver [e]	P	NA	3	0	0
	East	R	NS	NA	NS	7
	Northeast	R	NS	NA	NS	1
	Northwest	R	NA	NA	[d] 0 (4)	1
	South Central	R	NS	NS	NS	NS
	Southeast	R	NA	NA	[d] 0	0
	Southwest	R	NA	NA	[d] 0	2
	West	R	NA	NA	[d] 0	0
Conn:	Hartford [e]	R	NA	5	14	4
	Central	P	6	6	6	11
Del:	Wilmington [e]	P	NA	7	0	6
D.C:	Washington [e]	P	NA	5	0	3
Fla:	Tampa [e]	P	4	4	25	31
	Central	R	5	5	34	37
	North	R	4	6	17	14
	Northeast	R	8	5	29	31
	Southeast	R	3	5	63	47
	Tampa Bay area	P	5	5	24	32
	West	R	6	7	13	8
Ga:	Atlanta [e]	P	NA	8	6	8
Hawaii:	Honolulu [e]	P	0	1	0	0
Idaho:	Idaho Falls [e]	P	4	3	0	0
Ill:	Chicago [e]	P	5	5	0	3
Ind:	Indianapolis [e]	P	NA	4	0	1
	Central	P	6	7	0	8
	Northeast	P	4	5	15	8
	Northwest	P	6	7	10	10
	Southeast	P	6	7	0	7
	Southwest	P	7	7	0	9
Iowa:	Des Moines [e]	P	NA	5	0	0
	Iowa City	P	4	6	0	3
	Des Moines	P	5 (3)	5	0 (3)	2
	Little Cedar	P	NS	4	NS	2
	Spencer	P	NS	6	NS	3
Kans:	Wichita [e]	P	NA	5	0	0
	Coffeyville	P	7	8	0	9
	Dodge City	P	7	5	0	5
	Falls City, Nebr	R	7	3	0	7
	Hays	P	6	9	0	7
	Kansas City	P	NS		NS	
	Topeka	P	6	7	0	5
	Wichita	P	9	8	0	10
Ky:	Louisville [e]	P	NA	6	0	2
La:	New Orleans [e]	P	5	11	0	1
Maine:	Portland [e]	P	NA	5	18	19
Md:	Baltimore [e]	P	NA	6	0	4
Mass:	Boston [e]	P	7	6	36	15
Mich:	Detroit [e]	P	NA	6	12	4
	Grand Rapids [e]	P	NA	7	0	0
	Bay City	P	15	6	0 (2)	0
	Charlevoix	P	11 (2)	5	0 (4)	5
	Detroit	P	7	4	0	1
	Grand Rapids	P	5	4	0	3
	Lansing	P	12	5	0	3
	Marquette	P	7	5	7 (2)	11
	Monroe	P	NS	3	NS	2
	South Haven	P	9 (3)	6	0 (5)	5
Minn:	Minneapolis [e]	P	NA	7	0	8
	Bemidji	P	6	6	0	14
	Duluth	P	14	15	11	23
	Fergus Falls	P	6	7	0	0
	Little Falls	P	18	18	0	17
	Mankato	P	5	5	0	0
	Marshall	P	3	4	0	0

See footnotes at end of table.

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Table 2. Concentrations of radionuclides in milk for May 1973 and 12-month period, June 1972 through May 1973—continued

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:—continued						
Minn:	Minneapolis	P	5	9	16	12
	Rochester	P	4	7	11	0
Miss:	Jackson [e]	P	NA	8	0	7
Mo:	Kansas City [e]	P	NA	5	0	0
	St. Louis [e]	P	NA	6	0	1
Mont:	Helena [e]	P	NA	4	0	0
Nebr:	Omaha [e]	P	NA	4	0	0
Nev:	Las Vegas [e]	P	NA	1	0	0
N.H:	Manchester [e]	P	NA	6	0	13
N.J:	Trenton [e]	P	NA	6	0	5
N. Mex:	Albuquerque [e]	P	NA	0	0	0
N.Y:	Buffalo [e]	P	4	5	13	4
	New York City [e]	P	NA	8	0	3
	Syracuse [e]	P	NA	6	0	2
	Albany	P	5	4	0	0
	Buffalo	P	0	4	0	0
	Massena	P	7	6	0	0
	New York City	P	NA	6	0	0
	Syracuse	P	5	5	0	0
N.C:	Charlotte [e]	P	NA	7	0	5
N. Dak:	Minot [e]	P	NA	8	0	1
Ohio:	Cincinnati [e]	P	NA	5	12	2
	Cleveland [e]	P	NA	6	0	2
Okla:	Oklahoma City [e]	P	NA	4	0	0
Oreg:	Portland [e]	P	8	4	0	2
	Baker	P	NA		[d] 12	3
	Coos Bay	P	NA		[d] 0	7
	Eugene	P	NA		[d] 0	0
	Medford	P	NA		[d] 0	7
	Portland composite	P	NA		[d] 0	2
	Portland local	P	NA		[d] 0	1
	Redmond	P	NA		[d] 0	2
	Tillamook	R	NA		[d] 11	13
Pa:	Philadelphia [e]	P	NA	6	0	2
	Pittsburgh [e]	P	NA	8	0	5
	Dauphin	P	5	5	0	3
	Erie	P	7	7	0	3
	Philadelphia	P	0	5	0	5
	Pittsburgh	P	0	6	0	4
R.I:	Providence [e]	P	NA	5	11	9
S.C:	Charleston [e]	P	5	7	13	9
	Chapin	R	8	8	0	11
	Clemson	R	8	7	0	4
	Columbia	R	NS	7	NS	11
	Fairfield	R	8	7	0	13
	Hartsville-02	R	NS	6	NS	15
	Hartsville-03	R	NS	18	NS	18
	Lee County	R	NS	8	NS	18
	Oconee County	R	8	8	0	7
	Pickens	R	7	7	0	4
	Williston	R	NS	7	NS	15
	Winnsboro	R	7	8	20	24
S. Dak:	Rapid City [e]	P	NA	5	0	0
Tenn:	Chattanooga [e]	P	NA	8	0	5
	Memphis [e]	P	NA	6	0	1
	Chattanooga	P	7	8	0	7
	Clinton	R	5	7	12 (2)	8
	Fayetteville	R	6	8	0 (2)	7
	Kingston	R	5	7	0 (2)	2
	Knoxville	P	4	6	11	4
	Lawrenceburg	R	NS	4	NS	7
	Nashville	P	5	7	0	3
	Pulaski	R	6	6	0 (3)	4
	Sequoyah	R	NA	7	0	8
Tex:	Austin [e]	P	NA	2	0	0
	Dallas [e]	P	NA	5	0	0
	Amarillo	R	NA		NA	
	Corpus Christi	R	NA		NA	
	El Paso	R	NA		NA	
	Fort Worth	R	NA		NA	
	Harlingen	R	NA		NA	
	Houston	R	NA		NA	
	Lubbock	R	NA		NA	
	Midland	R	NA		NA	
	San Antonio	R	NA		NA	
	Texarkana	R	NA		NA	
	Uvalde	R	NA		NA	
	Wichita Falls	R	NA		NA	

See footnotes at end of table.

Table 2. Concentration of radionuclides in milk for May 1973 and 12-month period, June 1972 through May 1973—continued

Sampling location	Type of sample [a]	Radionuclide concentration (pCi/liter)			
		Strontium-90		Cesium-137	
		Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:—continued					
Utah: Salt Lake City [c]	P	3	3	0	2
Vt: Burlington [c]	P	NA	5	11	7
Va: Norfolk [c]	P	NA	6	0	3
Wash: Seattle [c]	P	NA	4	0	1
Spokane [c]	P	NA	4	0	1
Benton County	R	0	1	0	0
Franklin County	R	NS	1	NS	0
Longview	R	6	4	0	2
Sandpoint, Idaho	R	6	7	0	3
Skagit County	R	4	6	0	3
W. Va: Charleston [c]	P	NA	7	11	4
Wisc: Milwaukee [c]	P	NA	5	0	3
Wyo: Laramie [c]	P	NA	2	0	0
CANADA:					
Alberta: Calgary	P	NA		11	11
Edmonton	P	NA		13	16
British Columbia:					
Vancouver	P	NA		10	17
Manitoba:					
Winnipeg	P	NA		10	12
New Brunswick:					
Moncton	P	NA		15	9
Newfoundland:					
St. John's	P	NA		16	22
Nova Scotia:					
Halifax	P	NA		13	12
Ontario: Ottawa	P	NA		8	8
Sault Ste. Marie	P	NA		16	18
Thunder Bay	P	NA		8	15
Toronto	P	NA		9	8
Windsor	P	NA		10	7
Quebec: Monteal	P	NA		9	8
Quebec	P	NA		17	15
Saskatchewan:					
Regina	P	NA		12	9
Saskatoon	P	NA		9	10
CENTRAL AND SOUTH AMERICA:					
Canal Zone:					
Cristobal [c]	P	NA	1	0	13
Chile: Santiago	P	0	1	0	1
Colombia: Bogota	P	NS	0	NS	0
Ecuador: Guayaquil	P	0	0	0	0
Jamaica: Mandeville	P	4	2	24	47
Puerto Rico:					
San Juan [c]	P	NA	1	12	2
Venezuela:					
Caracas	P	0	0	13	2
PMN network average [e]		5	5	3	4

[a] P, pasteurized milk.
R, raw milk.

[b] When an individual sampling result was equal to or less than the practical reporting level, a value of "0" was used for averaging. Monthly averages less than the practical reporting level reflect the fact that some but not all of the individual samples making up the average contained levels greater than the practical reporting level. When more than one analysis was made in a monthly period, the number of samples in the monthly average is given in parentheses.

[c] Pasteurized Milk Network station. All other sampling locations are part of the State or National network.

[d] The practical reporting level for this network differs from the general ones given in the text. Sampling results for these networks were equal to or less than the following practical reporting levels:
Cesium-137: Colorado—25 pCi/liter; Oregon—15 pCi/liter.

[e] This entry gives the average radionuclide concentrations for the Pasteurized Milk Network stations denoted by footnote [c].
NA, no analysis.
NS, no sample collected.

in figure 2. The first column in table 2 under each of the reported radionuclides gives the monthly average for the station and the number of samples analyzed in that month in parentheses. When an individual sampling result is equal to or below the practical reporting level for the radionuclide, a value of zero is used for averaging. Monthly averages are calculated using the above convention. Averages which are equal to or less than the practical reporting

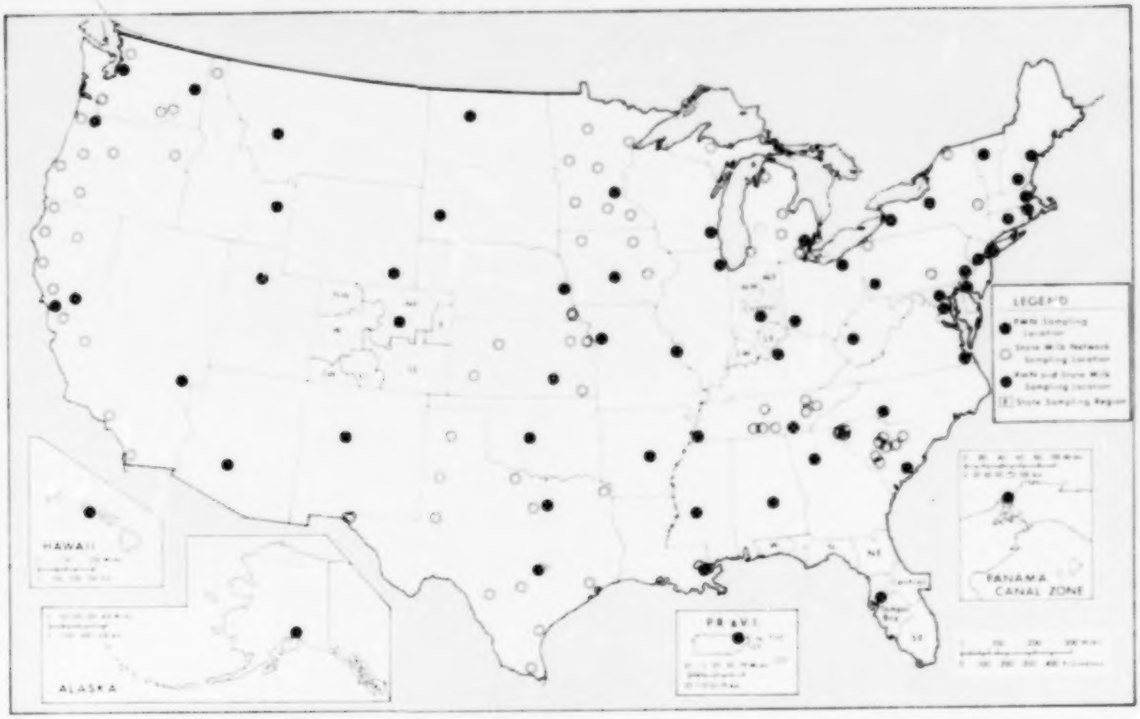

Figure 2. State and PMN milk sampling stations in the United States

levels reflect the presence of radioactivity in some of the individual samples greater than the practical reporting level.

The second column under each of the radionuclides reported gives the 12-month average for the station as calculated from the preceding 12 monthly averages, giving each monthly average equal weight. Since the daily intake of radioactivity by exposed population groups, averaged over a year, constitutes an appropriate criterion for the case where the FRC radiation protection guides apply, the 12-month average serves as a basis for comparison.

Discussion of current data

In table 2, surveillance results are given for strontium-90 and cesium-137 for May 1973 and the 12-month period, June 1972 to May 1973. Except where noted, the monthly average represents a single sample for the sampling station. Strontium-89, iodine-131, and barium-140 data have been omitted from table 2 since levels at the great majority of the stations for May 1973 were below the respective practical reporting levels. Barium-140 results for individual samples were all below the practical reporting level with the following exception: Kansas, Kansas City (State), 13 pCi/liter.

Strontium-90 monthly averages ranged from 0 to 18 pCi/liter in the United States for May 1973 and the highest 12-month average was 18 pCi/liter (Hartsville–03, S.C. and Little Falls, Minn.) representing 9.0 percent of the Federal Radiation Council radiation protection guide. Cesium-137 monthly averages ranged from 0 to 63 pCi/liter in the United States for May 1973, and the highest 12-month average was 47 pCi/liter (Southeast Florida) representing 1.3 percent of the value derived from the recommendations given in the Federal Radiation Council report.

Acknowledgement

Appreciation is expressed to the personnel of the following agencies who provide **data from their milk surveillance networks**:

Bureau of Radiological Health
Environmental Health and Consumer Protection Program
California Department of Public Health

Radiation Protection Division
Canadian Department of National Health and Welfare

Radiological Health Section
Division of Occupational and Radiological Health
Colorado Department of Health

Radiological Health Services
Division of Medical Services
Connecticut State Department of Health

Radiological and Occupational Health Section
Department of Health and Rehabilitative Services
State of Florida

Bureau of Environmental Sanitation
Division of Sanitary Engineering
Indiana State Board of Health

Division of Radiological Health
Environmental Engineering Services
Iowa State Department of Health

Radiation Control Section
Environmental Health Division
Kansas State Department of Health

Radiological Health Services
Division of Occupational Health
Michigan Department of Health

Radiation Control Section
Division of Environmental Health
State of Minnesota Department of Health

Bureau of Radiological Pollution Control
New York State Department of Environmental Conservation

Environmental Radiation Surveillance Program
Division of Sanitation and Engineering
Oregon State Board of Health

Radiological Health Section
Bureau of Environmental Health
Pennsylvania Department of Public Health

Division of Radiological Health
South Carolina State Board of Health

Radiological Health Services
Division of Preventable Diseases
Tennessee Department of Public Health

Division of Occupational Health
Environmental Health Services
Texas State Department of Health

Radiation Control Section
Division of Health
Washington Department of Social and Health Services

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Milk Surveillance Programs, March 1973

National Environmental Research Center—Las Vegas, Environmental Protection Agency

The Milk Surveillance Network,[1] operated by the National Environmental Research Center (NERC-LV) consists of 24 routine and two alternate sampling locations (figure 1) situated in the offsite area surrounding the Nevada Test Site (NTS). This routine network is operated in support of the nuclear testing sponsored by the U.S. Atomic Energy Commission (AEC) at the Nevada Test Site (NTS).

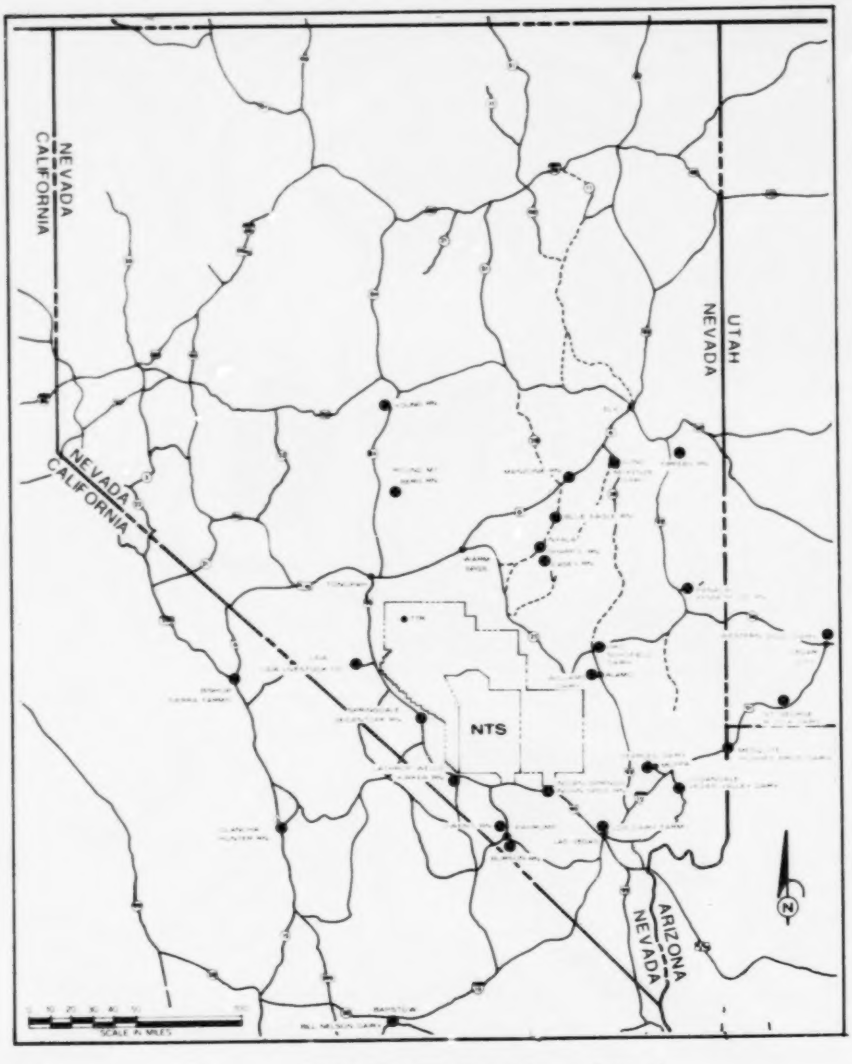
NEVADA
CALIFORNIA
NEVADA
CALIFORNIA
UTAH
NEVADA
NTS
ARIZONA
NEVADA
N
SCALE IN MILES

Figure 1. NERC-LV Milk Surveillance Network

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[1] This network is operated under a Memorandum of Understanding (No. (AT-26-1)-539) with the Nevada Operations Office, U.S. AEC, Las Vegas, Nev.

Table 1. Milk surveillance results, March 1973

Location	Date collected (1973)	Sample type [a]	Radionuclide concentrations [b] (pCi/liter)			
			Cesium-137	Strontium-89	Strontium-90	Tritium
California:						
Bishop:						
Sierra Farms	3/1	11	<10	NA	NA	NA
Hinkley:						
Bill Nelson Dairy	3/1	12	<10	NA	NA	NA
Olancha:						
Hunter Ranch	NS					
Nevada:						
Alamo:						
Williams Dairy	3/1	12	<10	NA	NA	NA
Austin:						
Young's Ranch	3/1	13	<10	NA	NA	550 ±260
Currant:						
Blue Eagle Ranch	3/1	13	<10	NA	NA	NA
Manzonie Ranch	3/2	13	<10	NA	NA	NA
Hiko:						
Schofield Dairy	3/1	12	<10	NA	NA	<230
Indian Springs:						
Indian Springs Ranch	NS					
Las Vegas:						
LDS Dairy Farms	3/1	12	<10	NA	NA	330 ±240
Lathrop Wells:						
Kirker Ranch	3/1	13	<10	NA	NA	NA
Lida:						
Lida Livestock Company	NS					
Logandale:						
Vegas Valley Dairy	3/1	12	<10	NA	NA	NA
Lund:						
McKenzie Dairy	3/1	12	<10	NA	NA	<240
Mesquite:						
Hughes Brothers Dairy	3/1	12	<10	NA	NA	<230
Moapa:						
Searles Dairy	3/1	12	<10	NA	NA	NA
Nyala:						
Sharp's Ranch	3/1	13	[c] <100	NA	NA	<230
Pahrump:						
Owens Ranch	3/1	13	<10	NA	NA	NA
Panaca:						
Kenneth Lee Ranch	3/1	13	<10	NA	NA	NA
Round Mountain:						
Berg Ranch	3/1	13	<10	NA	NA	NA
Shoshone:						
Kirkeby Ranch	3/1	13	<10	NA	NA	NA
Springdale:						
Seidentopf Ranch	3/1	13	<10	NA	NA	NA
Utah:						
Cedar City:						
Western Gold Dairy	3/1	12	<10	NA	NA	NA
St. George:						
R. Cox Dairy	3/1	12	<10	NA	NA	NA

[a] 11—Pasteurized milk.
12—Raw milk from Grade A producer(s).
13—Raw milk from family cow(s).
[b] Two-sigma counting error provided when available.
[c] Small sample size increased minimum detectable activity.
NA, not analyzed.
NS, no sample.

In the event of a release of radioactivity from the NTS, special sampling within the affected area is conducted to determine radionuclide concentrations. Additional milk sampling networks are operated in support of AEC operations in areas other than the NTS when requested. A complete description of sampling and analytical procedures was included with the milk results reported in the July 1973 issue of *Radiation Data and Reports.*

Results

The analytical results of all milk samples collected in March 1973 by NERC-LV surveillance programs are listed in table 1. With the exception of cesium-137 at levels near the minimum detectable activity (MDA) of 10 pCi/liter, no gamma-emitting fission products were identified by gamma spectrometry in any of the samples collected in March 1973. Levels of tritium near the MDA for this radionuclide (200 pCi/liter) were also measured by liquid scintillation. The highest concentration of tritium during March was 550 ± 260 pCi/liter.

Food and Diet Surveillance

Efforts are being made by various Federal and States agencies to estimate the dietary intake of selected radionuclides on a continuing basis. These estimates, along with the guidance developed by the Federal Radiation Council, provide a basis for evaluating the significance of radioactivity in foods and diet.

Networks presently in operation and reported routinely include those listed below. These networks provide data useful for developing estimates of nationwide dietary intake of radionuclides. Programs reported in *Radiation Data and Reports* are as follows:

Program	Period reported	Issue
California Diet Study	January–June 1971	December 1972
Carbon-14 in Total Diet and Milk	July–December 1971	May 1972
Institutional Diet Samples	July–September 1972	August 1973
Radiostrontium in Milk	January–December 1971	November 1972
Strontium-90 in Tri-City Diets	January–December 1971	December 1972

Radionuclides in Institutional Diet Samples, October–December 1972 and 1972 Annual Summary

Environmental Protection Agency
Food and Drug Administration

The determination of radionuclide concentrations in the diet constitutes an important element of an integrated program of environmental radiological surveillance and assessment. Recognizing that the diet is a potentially significant contribution to total environmental radiation exposures, the Public Health Service initiated its Institutional Diet Sampling Program in 1961. The program is now administered by the Office of Radiation Programs, Environmental Protection Agency with the assistance of the Office of Food Sanitation, Food and Drug Administration, Department of Health, Education and Welfare (*1*).

This program estimates the dietary intake of radionuclides in a selected population group, ranging from children to young adults of school age. At present 26 institutions—distributed geographically as shown in figure 1—are being sampled. Previous results showed that the daily dietary intake of teenage girls and children from 9 to 12 years of age were comparable, but teenage boys consumed 20 percent more food per day (*1,2*). Extrapolating this information, estimates for teenage boys and/or girls can be calculated on the basis of the dietary intake of children.

The sampling procedure is generally the same at each institution. Each sample represents the edible portion of the diet for a full 7-day week (21 meals plus between-meal snacks), obtained by duplicating the food intake of a different

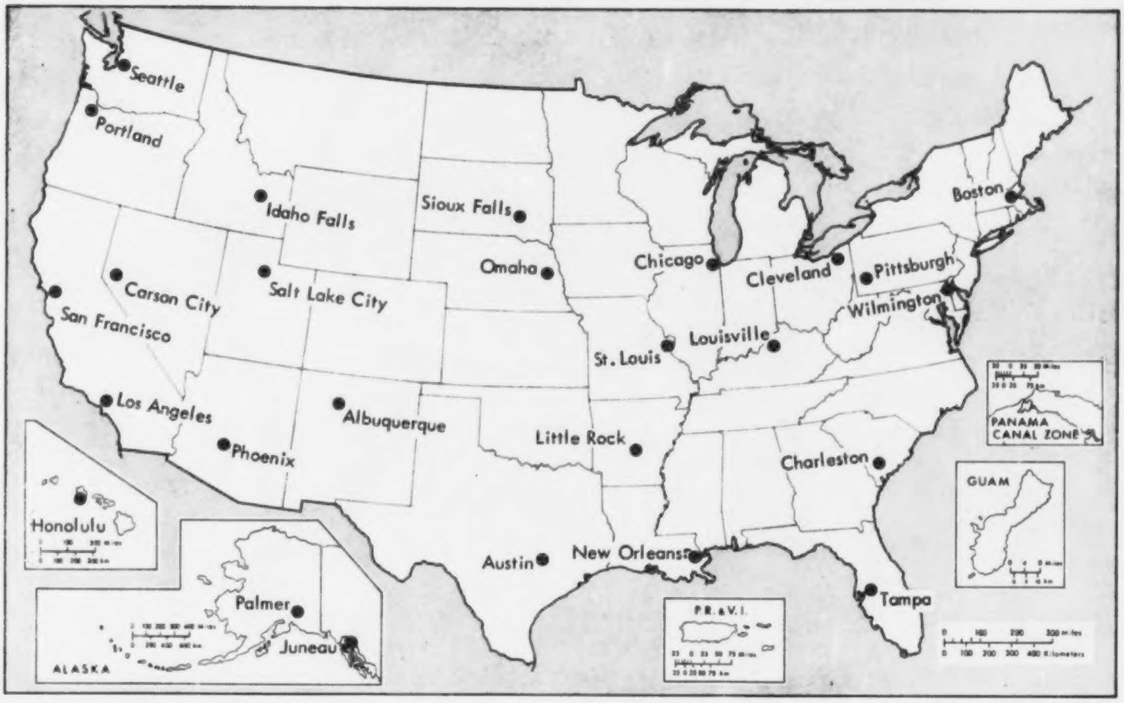
Seattle
Portland
Idaho Falls
Sioux Falls
Omaha
Chicago
Cleveland
Pittsburgh
Boston
Wilmington
Carson City
Salt Lake City
San Francisco
St. Louis
Louisville
Los Angeles
Albuquerque
Little Rock
Phoenix
Charleston
Honolulu
Austin
New Orleans
Tampa
Palmer
Juneau
ALASKA
PANAMA CANAL ZONE
GUAM
P.R. & V.I.
0 100 200 300 Miles
0 100 200 300 400 Kilometers

Figure 1. Institutional diet sampling locations as of December 1972

Table 1. Concentration and intake of stable elements and radionuclides in institutional total diets of children, October–December 1972

Location of Institution	Month [a] (1972)	Total weight (kg/day)	Calcium		Potassium		Strontium-90		Cesium-137	
			(g/kg)	(g/day)	(g/kg)	(g/day)	(pCi/kg)	(pCi/day)	(pCi/kg)	(pCi/day)
Alaska: Juneau	Oct	2.26	0.7	1.6	1.2	2.7	5	11	0	0
Palmer	Dec [b]	1.21	.4	.5	1.4	1.7	3	3	0	0
Ariz: Phoenix	Oct	1.89	.5	.9	1.5	2.9	2	4	0	0
Ark: Little Rock	Oct	1.47	.4	.6	1.7	2.4	3	5	0	0
Calif: Los Angeles		NS								
San Francisco	Oct [b]	1.53	.6	.9	2.0	3.1	2	4	0	0
Del: Wilmington	Nov	1.21	.8	.9	1.3	1.5	6	7	0	0
Fla: Tampa	Nov	1.85	.6	1.2	1.4	2.7	6	11	15	28
Hawaii: Honolulu	Oct [b]	2.00	.5	1.1	1.8	3.7	3	5	0	0
Idaho Idaho Falls	Oct [b]	1.24	.3	.4	1.8	2.2	4	5	0	0
Ill: Chicago		NS								
Ky: Louisville	Nov	2.36	.8	1.9	1.5	3.5	5	11	0	0
La: New Orleans	Oct [b]	1.65	.6	1.0	2.1	3.5	4	7	13	21
Mass: Boston	Oct [b]	2.32	.6	1.[illegible]	1.4	3.2	6	14	11	26
Mo: St. Louis	Oct [b]	1.09	.7	.7	1.6	1.8	5	6	0	0
Nebr: Omaha	Oct [b]	2.50	.8	1.9	1.6	4.0	5	13	0	0
Nev: Carson City	Oct	.90	.6	1.1	1.6	3.1	4	8	0	0
N. Mex: Albuquerque	Dec [b]	1.81	.6	1.2	1.8	3.2	3	6	0	0
Ohio: Cleveland	Oct [b]	.95	.5	.5	1.4	1.4	5	5	0	0
Oreg: Portland	Oct [b]	2.21	.5	1.1	1.6	3.6	3	7	0	0
Pa: Pittsburgh	Oct	2.10	.5	1.0	1.1	2.4	4	9	0	0
S.C: Charleston	Oct [b]	1.31	.6	.8	1.5	2.0	6	7	19	25
S. Dak: Sioux Falls	Oct [b]	1.02	.5	.5	1.3	1.4	2	2	0	0
Tex: Austin	Oct [b]	1.52	.7	1.0	1.5	2.3	0	0	0	0
Utah: Salt Lake City	Oct [b]	2.08	.5	1.0	1.3	2.6	2	5	0	0
Wash: Seattle	Oct [b]	1.92	.6	1.1	1.6	3.1	3	5	0	0
Institutional average		1.72	0.6	1.[illegible]	1.5	2.7	4	7	2	4

[a] Quarterly sample usually collected the first month of the quarter.

[b] Food samples were collected from two or more children who were not between the ages of 9 and 12.

Note: Iodine-131, barium-140, and strontium-89 were not detected at any station during this period.

NS, no sample.

Table 2. 1972 annual average concentration and intake of stable elements and radionuclides in institutional total diets of children[a]

Location of Institution		Total weight (kg/day)	Calcium		Potassium		Strontium-90		Cesium-137	
			(g/kg)	(g/day)	(g/kg)	(g/day)	(pCi/kg)	(pCi/day)	(pCi/kg)	(pCi/day)
Alaska:	Juneau[b]	2.06	0.7	1.4	1.5	3.1	4	8	21	43
	Palmer[b]	1.66	.5	.8	1.6	2.6	7	12	19	31
Ariz:	Phoenix	1.67	.5	.9	1.9	3.1	3	6	0	0
Ark:	Little Rock	1.51	6	.8	1.7	2.6	7	11	4	5
Calif:	Los Angeles[b]	1.41	.3	.4	1.3	1.9	2	3	0	0
	San Francisco[b]	1.77	.7	1.3	1.8	3.3	3	6	0	0
Del:	Wilmington[b]	1.06	.7	.8	1.3	1.4	5	6	6	6
Fla:	Tampa	1.97	.6	1.1	1.4	2.8	5	10	19	37
Hawaii:	Honolulu[b]	2.19	.5	1.1	1.7	3.7	3	7	0	0
Idaho:	Idaho Falls[b]	1.38	.6	.8	1.6	2.3	7	10	8	11
Ill:	Chicago[b]	1.13	.6	.6	1.6	1.8	5	6	19	21
Ky:	Louisville[b]	2.17	.8	1.6	1.5	3.3	6	13	3	7
La:	New Orleans[b]	1.42	.6	.8	1.9	2.7	6	9	10	15
Mass:	Boston[b]	2.46	.6	1.5	1.3	3.2	5	12	7	17
Mo:	St. Louis[b]	1.04	.7	.8	1.9	2.0	5	5	5	5
Nebr:	Omaha[b]	2.15	.7	1.6	1.6	3.4	5	10	0	0
Nev:	Carson City	1.46	.7	1.1	1.6	2.4	4	6	0	0
N. Mex:	Albuquerque[b]	1.86	.6	1.1	1.8	3.3	4	7	0	0
Ohio:	Cleveland[b]	1.12	.6	.7	1.5	1.7	6	7	9	10
Oreg:	Portland[b]	2.04	.5	1.0	1.7	3.5	4	9	8	15
Pa:	Pittsburgh[b]	2.64	.5	1.2	1.3	3.3	5	13	0	0
S.C:	Charleston[b]	1.61	.6	1.0	1.4	2.3	6	10	11	18
S. Dak:	Sioux Falls[b]	1.13	.6	.7	1.4	1.6	6	6	0	0
Tex:	Austin[b]	1.38	.7	1.0	1.7	2.4	4	5	0	0
Utah:	Salt Lake City[b]	2.19	.5	1.1	1.5	3.2	3	6	3	7
Wash:	Seattle[b]	1.88	.5	1.0	1.7	3.2	3	5	3	5
Institutional average		1.71	0.6	1.0	1.6	2.7	5	8	8	10

[a] Iodine-131 and barium-140 were not detected at any station during this period. Strontium-89 was detected as follows: Omaha, Nebr.—7 pCi/kg or 13 pCi/day in April; Juneau, Alaska—6 pCi/kg or 9 pCi/day in July; and Seattle, Wash.—7 pCi/kg or 12 pCi/day in July.

[b] Food samples were collected from two or more children who were not between the ages of 9 and 12.

individual daily. Drinking water—which is not included—is also sampled periodically. Each daily sample is kept frozen until the end of the collection period. It is then packed in dry ice and shipped by air to either the National Environmental Research Center, Las Vegas, Nev. or the Eastern Environmental Radiation Facility, Montgomery, Ala. A detailed description of sampling and analytical procedures has already been presented in *Radiological Health Data and Reports* (*3*).

Results

Table 1 shows the analytical results for institutional diet samples collected from all stations during October–December 1972. The stable elements calcium and potassium are reported in g/kg of diet. Where applicable, radionuclide concentrations of these samples reported in pCi/kg of diet are corrected for radioactive decay to the midpoint of the sample collection period. Dietary intakes in g/day or pCi/day were obtained by multiplying the food consumption rate in kg/day by the appropriate concentration values. The average food consumption rate during this period was 1.72 kg/day compared to the network average of 1.84 kg/day observed from 1961 through 1972.

Strontium-90 dietary intake averaged 7 pCi/day during this period. Cesium-137 intake averaged 4 pCi/day. These results fall within Range I as defined by the former Federal Radiation Council (*4*). Strontium-89, barium-140, and iodine-131 concentrations were below detectable levels.

All concentrations less than or equal to the appropriate minimum detectable level have been reported as zero. The minimum detectable concentration is defined as the measured concentration equal to the two standard-deviation analytical error. Accordingly, the minimum detectable limits are strontium-89, 5 pCi/kg; strontium-90, 2 pCi/kg; iodine-131, 10 pCi/kg; barium-140, 10 pCi/kg; cesium-137, 10 pCi/kg.

Annual average radionuclide concentrations and intakes are presented in table 2 for all stations. During 1972, the annual average intake for these institutions was 1.71 kg/day as compared to the network average of 1.84 kg/day observed from 1961–1972. The average levels of radionuclide concentrations are similar to those of previous years.

Recent coverage in *Radiation Data and Reports:*

Period	Issue
October–December 1971	June 1972
January–March 1972	June 1973
April–June 1972	July 1973
July–September 1972	August 1973

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SECTION II. WATER

The Environmental Protection Agency and other Federal, State, and local agencies operate extensive water quality sampling and analysis programs for surface, ground, and treated water. Most of these programs include determinations of gross beta and gross alpha radioactivity and specific radionuclides.

Although the determination of the total radionuclide intake from all sources is of primary importance, a measure of the public health importance of radioactivity levels in water can be obtained by comparison of the observed values with the Public Health Service Drinking Water Standards (*1*). These standards, based on consideration of Federal Radiation Council (FRC) recommendations (*2-4*) set the limits for approval of a drinking water supply containing radium-226 and strontium-90 at 3 pCi/liter and 10 pCi/liter, respectively. Higher concentrations may be acceptable if the total intake of radioactivity from all sources remains within the guides recommended by FRC for control action. In the known absence[1] of strontium-90 and alpha-particle emitters, the limit is 1,000 pCi/liter gross beta radioactivity, except when additional analysis indicates that concentrations of radionuclides are not likely to cause exposures greater than the limits indicated by the Radiation Protection Guides. Surveillance data from a number of Federal and State programs are published periodically to show current and long-range trends. Water sampling activities reported in *Radiation Data and Reports* are listed below.

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[1] Absence is taken to mean a negligibly small fraction of the specific limits of 3 pCi/liter and 10 pCi/liter for unidentified alpha-particle emitters and strontium-90, respectively.

Water sampling program	Period reported	Issue
California	January–December 1970	June 1972
Colorado River Basin	1968	March 1972
Community Water Supply Study	1968	September 1972
Florida	1969	January 1972
Interstate Carrier Drinking Water	1971	May 1972
Kansas	January–December 1971	February 1973
Michigan	January–June 1970	November 1971
Minnesota	July 1970–June 1971	November 1972
New York	July–December 1971	August 1973
North Carolina	1968–1970	September 1972
Radiostrontium in Tap Water, *HASL*	July–December 1971	November 1972
Surface Waters	January 1969–December 1970	July 1973
Tritium Surveillance System	January–March 1973	July 1973
Washington	July 1970–June 1971	August 1973
Water Surveillance Programs, *NERC-LV*	February 1973	August 1973

REFERENCES

(*1*) U.S. PUBLIC HEALTH SERVICE. Drinking water standards, revised 1962, PHS Publication No. 956. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (March 1963).

(*2*) FEDERAL RADIATION COUNCIL. Radiation Protection Guidance for Federal Agencies. Memorandum for the President, September 1961. Reprint from the Federal Register of September 26, 1961.

(*3*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 1. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (May 1960).

(*4*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 2. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (September 1961).

Gross Radioactivity in Surface Waters of the United States December 1972

Office of Radiation Programs
U.S. Environmental Protection Agency

The monitoring of gross radioactivity in surface waters of the United States was initiated in 1967 as part of the Water Pollution Surveillance System (formerly National Water Quality Network) of the U.S. Public Health Service. Currently, the program is operated by the U.S. Environmental Protection Agency, Office of Radiation Programs. Regional offices of the Environmental Protection Agency are responsible for the collection and retrieval system. Radioactivity analyses were performed at the Eastern Environmental Radiation Facility, Montgomery, Ala.

Table 1 presents the gross alpha and beta radioactivity results for samples collected from rivers during December 1972. The analytical procedures used for determining gross alpha and beta radioactivity are described in the 13th Edition of *Standard Methods for the Examination of Water and Wastewater* (*1*). Results are collected for the date of counting and are not corrected to the date of collection. The sensitivity in counting is that defined by the National Bureau of Standards, Handbook 86 (*2*) and is calculated to be < 1 pCi/liter for gross alpha and gross beta radioactivity measurements.

Due to the low levels of radioactivity in the rivers of the United States, this network was discontinued effective December 31, 1972.

REFERENCES

(*1*) AMERICAN PUBLIC HEALTH ASSOCIATION: AMERICAN WATER WORKS ASSOCIATION AND WATER POLLUTION CONTROL FEDERATION. Standard methods for the examination of water and wastewater, 13th Edition, New York, N.Y. (1971).

(*2*) U.S. DEPARTMENT OF COMMERCE. Radioactivity, Recommendations of the International Commission on Radiological Units and Measurements (1962), NBS Handbook 86 (November 29, 1963).

Table 1. Gross radioactivity in U.S. surface waters, December 1972

River and station	Number of grab samples	Gross alpha radioactivity (pCi/liter)		Gross beta radioactivity (pCi/liter)	
		Suspended solids	Dissolved solids	Suspended solids	Dissolved solids
Roanoke River:					
John Kerr Dam, Va	4	<1	<1	<1	3
		<1	<1	<1	2
		<1	<1	<1	3
		<1	<1	<1	2
St. Lawrence River:					
Massena, N.Y.	3	<1	<1	<1	4
		<1	<1	<1	3
		<1	<1	<1	[illegible]
St. Clair River:					
Port Huron, Mich	1	<1	<1	<1	3
St. Mary's River:					
Sault Ste. Marie, Mich	1	<1	<1	<1	<1

Water Surveillance Programs, March 1973

National Environmental Research Center—Las Vegas, Environmental Protection Agency

The Water Surveillance Network,[1] operated by the National Environmental Research Center—Las Vegas (NERC-LV), consists of 61 sampling locations (figures 1 and 2) situated in the offsite area surrounding the Nevada Test Site (NTS). This routine network is operated in support of the nuclear testing programs conducted by the U.S. Atomic Energy Commission (AEC) at the Nevada Test Site.

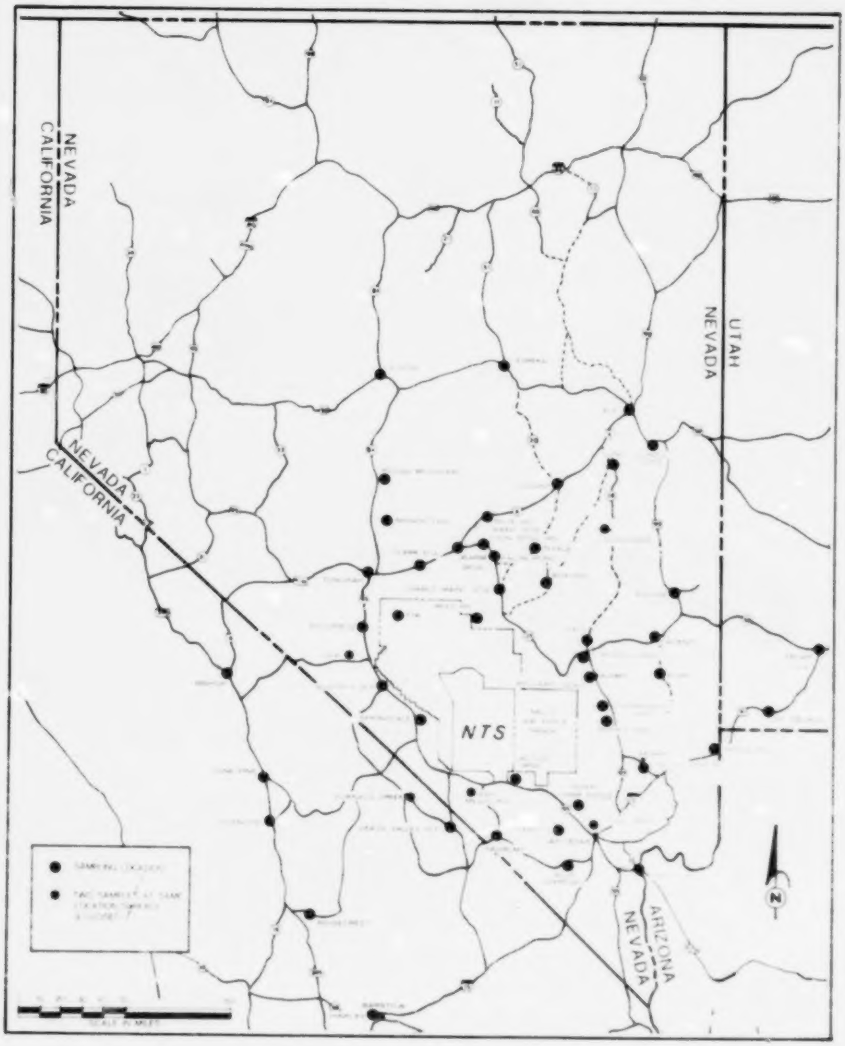
NEVADA
CALIFORNIA
NEVADA
CALIFORNIA
UTAH
NEVADA
NTS
ARIZONA
NEVADA
SAMPLING LOCATION
TWO SAMPLES AT SAME LOCATION
SCALE IN MILES

Figure 1. NERC-LV Water Surveillance Network

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[1] This network is operated under a Memorandum of Understanding (No. (AT-26-1)-539) with the Nevada Operations Office, U.S. AEC, Las Vegas, Nev.

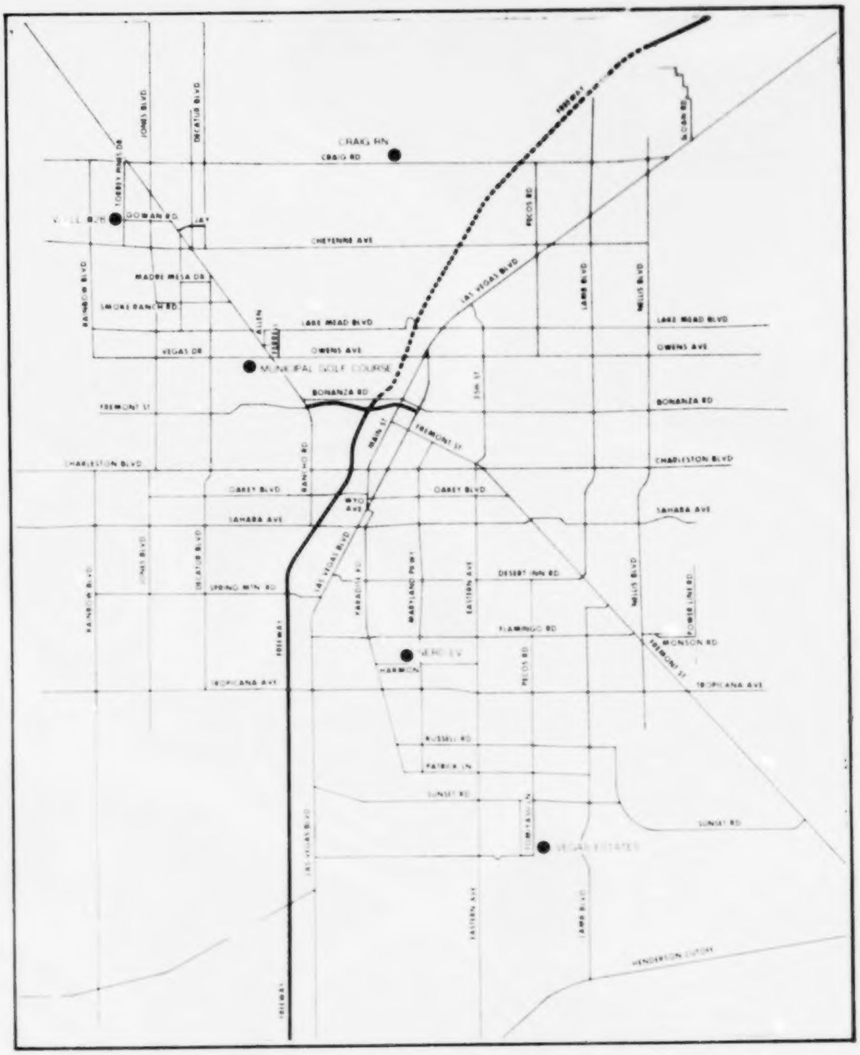
CRAIG RN
CRAIG RD
JONES BLVD
DECATUR BLVD
TORREY PINES DR
GOWAN RD
JAY
CHEYENNE AVE
MADRE MESA DR
SMOKE RANCH RD
RAINBOW BLVD
ALLEN
LAKE MEAD BLVD
VEGAS DR
OWENS AVE
MUNICIPAL GOLF COURSE
BONANZA RD
FREMONT ST
CHARLESTON BLVD
RANCHO RD
MAIN ST
OAKEY BLVD
WYO AVE
SAHARA AVE
LAS VEGAS BLVD
PARADISE RD
MARYLAND PKWY
EASTERN AVE
SPRING MTN RD
DESERT INN RD
PECOS RD
LAMB BLVD
NELLIS BLVD
POWER LINE RD
FLAMINGO RD
MONSON RD
NERC-LV
HARMON
TROPICANA AVE
FREEWAY
RUSSELL RD
PATRICK LN
SUNSET RD
VEGAS ESTATES
HENDERSON CUTOFF

Figure 2. NERC-LV Water Surveillance Network—Las Vegas Valley

In the event of a release of radioactivity from the NTS, special sampling within the affected area is conducted to determine radionuclide concentrations. Additional water sampling networks are operated in support of AEC operations in areas other than the NTS when requested. A complete description of sampling and routine analytical procedures was included with the water results reported in the July 1973 issue of *Radiation Data and Reports.*

Results

The routine analytical results of all water samples collected in March 1973 by the NERC-LV water surveillance network are listed in table 1. No gamma-emitting fission products were identified by gamma spectrometry in any of the samples collected in March. The analytical results for calendar year 1973 samples selected for special analyses will be reported at a later date.

Table 1. NERC-LV water surveillance results, March 1973

Location	Date collected (March 1973)	Sample type [a]	Radioactivity concentration [b] (pCi/liter)		
			Gross alpha	Gross beta	Tritium
California:					
Bishop:					
Fish and Game Office	1	23	<1.6	<3.3	NA
Death Valley Junction:					
Lila's Cafe	1	23	<5.1	9.3±3.9	<240
Furnace Creek:					
Pond	1	21	<3.6	13 ±4.0	NA
Visitors Center	1	27	<4.0	8.2±3.8	NA
Hinkley:					
Bill Nelson Dairy	1	23	8.1± 5.4	4.0±3.7	NA
Lone Pine:					
Forest Service Ranger Station	1	23	<1.9	<3.3	NA
Olancha:					
Haiwee Reservoir	1	21	4.7± 3.7	4.4±3.4	NA
Ridgecrest:					
City Hall	1	23	<2.3	<3.4	NA
Nevada:					
Adaven:					
Canfield Ranch	NS				
Alamo:					
Pahranagat Lake	1	21	13 ± 6.4	13 ±4.2	NA
Sheri's Bar	1	23	<3.4	<3.4	NA
Williams Dairy	1	23	<3.1	9.0±3.8	NA
Ash Meadows:					
Ash Meadows Lodge	1	23	1.4± .95	14 ±4.0	<240
Ash Meadows Pond	1	21	24 ±10	16 ±4.5	NA
Austin:					
Nevada National Bank	NS				
Blue Diamond:					
Post Office	1	23	<2.8	9.6±3.9	<240
Blue Jay Highway:					
Maintenance Station	1	23	4.2± 3.4	5.3±3.7	NA
Cactus Springs:					
Mobil Service Station	1	27	<2.3	<3.5	<240
Caliente:					
Agricultural Extension Station	1	23	7.6± 4.4	6.1±3.7	NA
Clark Station:					
Five Mile Ranch	1	27	<2.5	<3.6	NA
Currant:					
Currant Ranch Cafe	1	27	11 ± 5.4	<3.6	NA
Diablo:					
Highway Maintenance Station	1	23	4.0± 3.5	5.6±3.7	NA
Reed Ranch	2	21	23 ± 7.9	3.7±3.4	NA
Elgin:					
Water tower	1	23	7.7± 5.1	6.7±3.6	NA
Ely:					
Chevron Service Station	1	24	3.2± 2.6	<3.5	NA
Comins Lake	NS				
Eureka Highway:					
Maintenance Station	1	24	4.7± 3.3	<3.6	NA
Goldfield:					
Chevron Service Station	1	23	<3.1	<3.4	NA
Hiko:					
Crystal Springs	1	27	4.7± 3.8	7.0±3.6	NA
Schofield Dairy	1	23	18 ± 7.0	22 ±4.4	NA
Las Vegas:					
Craig Ranch Golf Course	1	23	<2.9	<3.5	<240
Desert Game Range	1	23	4.1± 3.3	6.3±3.7	<240
Lab II, NERC-LV	1	24	<5.0	6.6±3.9	950±250
Lake Mead Vegas Wash	1	21	<3.7	5.0±3.8	900±250
LV Water District Well 28	1	23	<2.3	<3.5	<250
Municipal Golf Course	1	23	<2.6	<3.5	<250
Tule Springs	1	23	3.3± 3.0	<3.5	<240
Tule Springs Pond	1	21	5.0± 3.3	<3.5	NA
Vegas Estates	1	23	<5.4	12 ±4.2	<250
Lida:					
Lida Livestock Company	1	27	4.1± 3.9	<3.6	NA
Pond at storage tank	1	21	<3.8	<3.4	NA
Lund:					
Gardiner Grocery	1	23	<2.5	<3.6	NA
Manhattan:					
Country Store	1	23	12 ± 6.7	<3.5	NA
Mesquite:					
Hughes Brothers Dairy	1	23	<4.4	5.2±3.6	NA
Moapa:					
Pedersen Valley View Ranch	1	27	7.8± 5.5	14 ±4.1	NA
Mt. Charleston:					
Kyle Canyon Fire Station	1	27	<2.2	<3.5	<250
Nyala:					
Sharp's Ranch	1	23	<2.2	<3.6	NA
Pahrump:					
Texaco Service Station	1	23	<2.3	<3.6	NA
Pioche:					
County Courthouse	1	24	<2.3	6.7±3.5	NA

See footnotes at end of table.

Table 1. NERC-LV water surveillance results, March 1973—continued

Location	Date collected (March 1973)	Sample type [a]	Radioactivity concentration [b] (pCi/liter)		
			Gross alpha	Gross beta	Tritium
Round Mountain:					
Mobil Service Station	1	27	<2.0	<3.5	NA
Scotty's Junction:					
Chevron Service Station	1	23	6.8 ± 5.9	10 ± 3.9	<240
Springdale:					
Pond	1	21	12 ± 6.7	5.9 ± 3.9	NA
Sunnyside:					
Adam McGill Reservoir	NS				
Wildlife Mgt. Headquarters	1	27	<1.8	<3.5	NA
Tonopah:					
Jerry's Chevron Station	1	23	<3.6	5.0 ± 3.5	NA
Tonopah Test Range CP-1	1	23	4.9 ± 4.2	6.4 ± 3.6	NA
Warm Springs:					
Fallini's Pond	1	21	28 ± 10	34 ± 5.3	NA
Service Station and Cafe	2	27	24 ± 9.7	26 ± 4.8	NA
Twin Springs Ranch	1	23	<3.5	11 ± 3.9	NA
Utah:					
Cedar City:					
M. D. Baldwin Residence	2	24	<2.1	<3.5	NA
St. George:					
R. Cox Dairy	1	24	2.9 ± 2.2	<3.3	NA

[a] 21—pond, lake, reservoir, stock tank, or stock pond.
22—stream, river, or creek.
23—well.
24—multiple supply-mixed water sample consisting of mixed or multiple sources of water, such as well and spring.
27—spring.

[b] Two-sigma counting error provided when available.
NA, not analyzed.
NS, no sample.

SECTION III. AIR AND DEPOSITION

Radioactivity in Airborne Particulates and Precipitation

Continuous surveillance of radioactivity in air and precipitation provides one of the earliest indications of changes in environmental fission product radioactivity. To date, this surveillance has been confined chiefly to gross beta radioanalysis. Although such data are insufficient to assess total human radiation exposure from fallout, they can be used to determine when to modify monitoring in other phases of the environment.

Surveillance data from a number of programs are published monthly and summarized periodically to show current and long-range trends of atmospheric radioactivity in the Western Hemisphere. These include data from activities of the Environmental Protection Agency, the Canadian Department of National Health and Welfare, and the Pan American Health Organization.

In addition to those programs presented in this issue, the following programs were previously covered in *Radiation Data and Reports.*

Network	Period	Issue
Mexican air monitoring	May–August 1972	January 1973
Plutonium in airborne particulates	October–December 1972	June 1973
Surface air sampling program, 80th Meridian Network, *HASL*	1970	May 1973

1. Radiation Alert Network
May 1973

Quality Assurance and Environmental
Monitoring Laboratory
National Environmental Research Center—
Research Triangle Park
Environmental Protection Agency

Surveillance of atmospheric radioactivity in the United States is conducted by the Radiation Alert Network (RAN) which regularly gathers samples at 68 locations distributed throughout the country (figure 1). Most of the stations are operated by State health department personnel.

The station operators perform "field estimates" on the airborne particulate samples at 5 hours after collection, when most of the radon daughter products have decayed, and at 29 hours after collection, when most of the thoron daughter products have decayed. They also perform field estimates on dried precipitation samples and report all results to appropriate Environmental Protection Agency officials by mail or telephone depending on levels found. A compilation of the daily field estimates is available upon request from the Quality Assurance and Environmental Monitoring Laboratory, NERC-RTP, EPA, Research Triangle Park, N.C. 27711. A detailed description of the sampling and analytical procedures was presented in the March 1968 issue of ***Radiological Health Data and Reports.***

Table 1 presents the monthly average gross beta radioactivity in surface air particulates and deposition by precipitation, as measured by the field estimate technique, during May 1973.

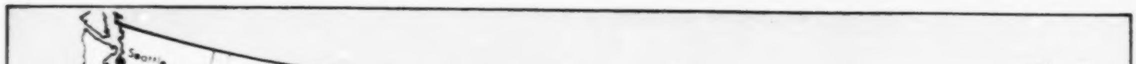

Figure 1. Radiation Alert Network sampling stations

200

Table 1. Gross beta radioactivity in surface air and precipitation, May 1973

Station location		Number of samples	Gross beta radioactivity (5-hour field estimate) (pCi/m³)			Precipitation				
						Number of samples	Total depth (mm)	Field estimation of deposition		
			Maximum	Minimum	Average[a]			Number of samples	Depth (mm)	Total deposition (nCi/m²)
Ala:	Montgomery	20	2	0	1	2	57	2	57	1
Alaska:	Anchorage	0				0		(b)		
	Attu Island	0				0				
	Fairbanks	0				0				
	Juneau	0				0				
	Nome	0				0				
	Point Barrow	0				0				
Ariz:	Phoenix	0				0				
Ark:	Little Rock	0				0				
Calif:	Berkeley	0				0				
	Los Angeles	0				0				
C.Z:	Ancon	18	0	0	0	0				
Colo:	Denver	23	5	0	1	6	138	(b)		
Conn:	Hartford	21	1	0	0	11	136	11	136	0
Del:	Dover	22	1	0	0	0				
D.C:	Washington	18	1	0	0	0				
Fla:	Jacksonville	21	1	0	0	6	149	6	149	0
	Miami	4	0	0	0	1	5	1	5	0
Ga:	Atlanta	0				0				
Guam:	Agana	0				0				
Hawaii:	Honolulu	0				0		(b)		
Idaho:	Boise	21	2	0	1	1	25	1	25	0
Ill:	Springfield	4	2	0	1	0				
Ind:	Indianapolis	20	2	0	1	0				
Iowa:	Iowa City	22	3	0	1	8	200	8	200	12
Kans:	Topeka	22	3	0	1	6	118	6	118	2
Ky:	Frankfort	18	2	0	0	0				
La:	New Orleans	20	0	0	0	5	167			
Maine:	Augusta	21	1	0	0	8	120	8	120	0
Md:	Baltimore	20	1	0	0	6	55	6	55	0
Mass:	Lawrence	20	1	0	0	9	118	9	118	0
	Winchester	18	1	0	0	7	71	7	71	0
Mich:	Lansing	22	1	0	0	11	94	11	94	9
Minn:	Minneapolis	17	2	0	1	7	130	7	130	21
Miss:	Jackson	1	0	0	0	6				
Mo:	Jefferson City	22	2	0	1	8	129	8	129	0
Mont:	Helena	13	2	0	1	0				
Nebr:	Lincoln	20	9	0	3	3	43	3	43	6
Nev:	Las Vegas	0				0				
N.H:	Concord	0				0				
N.J:	Trenton	21	1	0	0	12	110	12	110	3
N. Mex:	Santa Fe	17	3	0	1	1	5	1	5	0
N.Y:	Albany	22	2	0	1	0				
	Buffalo	21	1	0	0	0				
	New York City	0				0				
N.C:	Gastonia	22	9	0	2	2	38	(b)		
N. Dak:	Bismarck	21	9	0	2	3	74	3	74	1
Ohio:	Cincinnati	0				0				
	Columbus	0				0				
	Painesville	22	1	0	0	14	121	14	121	33
Okla:	Oklahoma City	4	2	0	1	0				
Oreg:	Portland	0				0				
Pa:	Harrisburg	19	1	9	0	0				
P.R:	San Juan	0				0				
R.I:	Providence	18	1	0	0	0				
S.C:	Columbia	10	1	0	0	4	61	4	61	0
S. Dak:	Pierre	0				0				
Tenn:	Nashville	22	2	0	1	7	105	7	105	1
Tex:	Austin	21	6	1	3	38		(b)		
	El Paso	17	4	0	1	0				
Utah:	Salt Lake City	29	2	0	1	4	51	4	51	2
Vt:	Barre	19	2	0	1	6	134	6	134	10
Va:	Richmond	17	1	0	0	3	21	3	21	1
Wash:	Seattle	0				0				
	Spokane	0				0		(b)		
W. Va:	Charleston	22	4	0	1	11	134	11	134	9
Wisc:	Madison	21	1	0	0	11	161	11	161	8
Wyo:	Cheyenne	16	5	0	2	0				
Network summary		829	9	0	1	186	108	7	93	5

[a] The monthly average is calculated by weighting the field estimates of individual air samples with length of sampling period.

[b] This station is part of the tritium surveillance system. No gross beta measurements are done.

2. Air Surveillance Network, May 1973

National Environmental Research Center—
Las Vegas[1] Environmental Protection
Agency

The Air Surveillance Network[2] (ASN), operated by the National Environmental Research Center—Las Vegas (NERC-LV), consists of 49 active and 73 standby sampling stations located in 21 western States (figures 2 and 3). The network is operated in support of nuclear testing conducted by the Atomic Energy Commission (AEC) at the Nevada Test Site (NTS), and at any other designated testing sites.

The stations are operated by State health department personnel and by private individuals on a contract basis. All active stations are operated continuously with filters being exchanged over periods generally ranging from 24 to 72 hours. All samples are mailed to the NERC-LV unless special retrieval is arranged at selected locations in response to known releases of radioactivity from the NTS. A complete description of sampling and analytical procedures was presented in the February 1972 issue of *Radiation Data and Reports.*

Results

Table 2 presents the monthly average gross beta concentrations in air for each of the network stations. The highest gross beta concentration within the network was 0.2 pCi/m^3 at Kingman, Ariz. and Barstow, Calif.; and Hiko and Blue Jay, Nev. The minimum reporting concentration for gross beta is 0.1 pCi/m^3. For averaging purposes, individual concentrations which are below the minimum detectable concentration (0.06 pCi/m^3) are assumed to be equal to the minimum detectable concentration. Averages less than the minimum reporting level (0.1 pCi/m^3) are reported as $<$ 0.1 pCi/m^3. No radionuclides were identified by gamma spectrometry on any filters or charcoal cartridges during May.

Complete copies of this summary and listings of the daily gross beta and gamma spectrometry results are distributed to EPA regional offices and appropriate State agencies. Additional copies of the daily results may be obtained from the NERC-LV upon written request.

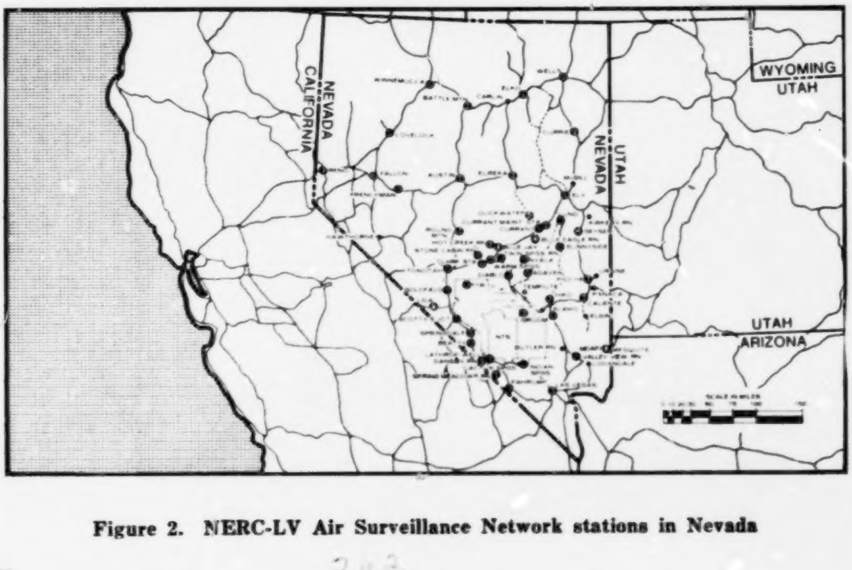

Figure 2. NERC-LV Air Surveillance Network stations in Nevada

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[1] Formerly the Western Environmental Research Laboratory.

[2] The ASN is operated under a Memorandum of Understanding (No. AT26-1)-539) with the Nevada Operations Office, U.S. Atomic Energy Commission.

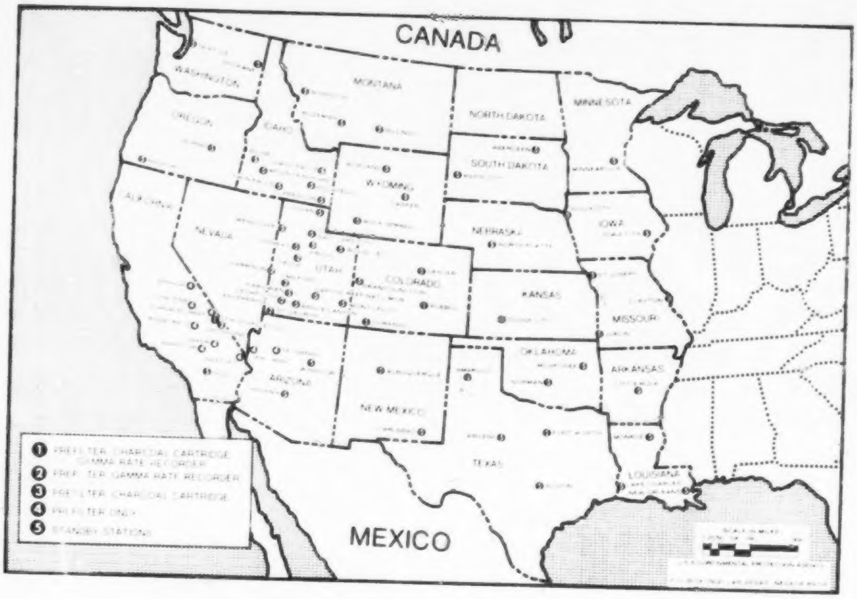
CANADA
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
OREGON
IDAHO
SOUTH DAKOTA
WYOMING
IOWA
CALIFORNIA
NEVADA
NEBRASKA
UTAH
COLORADO
KANSAS
MISSOURI
OKLAHOMA
ARKANSAS
ARIZONA
NEW MEXICO
TEXAS
LOUISIANA
MEXICO
❶ PREFILTER, CHARCOAL CARTRIDGE, GAMMA RATE RECORDER
❷ PREFILTER, GAMMA RATE RECORDER
❸ PREFILTER, CHARCOAL CARTRIDGE
❹ PREFILTER ONLY
❺ STANDBY STATIONS

Figure 3. NERC-LV Air Surveillance Network stations outside Nevada

Table 2. Summary of gross beta radioactivity concentrations in air, May 1973

Station		Number of samples	Concentration (pCi/m³)		
			Maximum	Minimum	Average[a]
Ariz:	Kingman	31	0.2	<0.1	0.1
	Seligman	31	<.1	<.1	<.1
Calif:	Baker	26	.1	<.1	.1
	Barstow	31	.2	<.1	.1
	Bishop	30	<.1	<.1	<.1
	Death Valley Junction	31	<.1	<.1	<.1
	Furnace Creek	31	<.1	<.1	<.1
	Lone Pine	27	.1	<.1	.1
	Needles	21	<.2	<.1	<.1
	Ridgecrest	31	<.1	<.1	<.1
	Shoshone	31	<.1	<.1	<.1
Nev:	Alamo	31	<.1	<.1	<.1
	Austin	24	<.1	<.1	<.1
	Beatty	31	<.1	<.1	<.1
	Blue Eagle Ranch (Currant)	30	.1	<.1	.1
	Blue Jay	31	.2	<.1	.1
	Caliente	31	<.1	<.1	<.1
	Currant Ranch	24	<.2	<.1	<.1
	Diablo	31	<.1	<.1	<.1
	Duckwater	25	<.1	<.1	<.1
	Ely	31	<.1	<.1	<.1
	Eureka	30	<.1	<.1	<.1
	Fallini's Twin Springs Ranch	31	<.1	<.1	<.1
	Geyser Maintenance Station	31	<.1	<.1	<.1
	Goldfield	29	.1	<.1	.1
	Groom Lake	23	<.2	<.1	<.1
	Hiko	31	.2	<.1	.1
	Indian Springs	31	<.1	<.1	<.1
	Las Vegas	22	.1	<.1	.1
	Lathrop Wells	31	<.1	<.1	<.1
	Lida	31	<.1	<.1	<.1
	Lund	27	<.1	<.1	<.1
	Mesquite	31	<.1	<.1	<.1
	Nyala	31	<.1	<.1	<.1
	Pahrump	29	<.1	<.1	<.1
	Pioche	29	<.1	<.1	<.1
	Round Mountain	30	<.1	<.1	<.1
	Scotty's Junction	31	<.1	<.1	<.1
	Stone Cabin Ranch	31	<.1	<.1	<.1

See footnotes at end of table.

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Table 2. Summary of gross beta radioactivity concentrations in air, May 1973—continued

Station	Number of samples	Concentration (pCi/m³)		
		Maximum	Minimum	Average [a]
Nev: Sunnyside	31	<.3	<.1	<.1
Tonopah	31	<.1	<.1	<.1
Tonopah Test Range	25	.1	<.1	.1
Warm Springs	31	.1	<.1	.1
Warm Springs Ranch	31	<.1	<.1	<.1
Utah: Cedar City	29	<.2	<.1	<.1
Delta	31	<.2	<.1	<.1
Garrison	31	<.1	<.1	<.1
Milford	31	<.1	<.1	<.1
St. George	31	<.1	<.1	<.1

[a] Individual values less than the minimum detectable concentration (MDC) are set equal to the MDC for averaging. A monthly average less than the minimum reportable value of 0.1 pCi/m³ is reported as <0.1.

3. Canadian Air and Precipitation Monitoring Program,[3] May 1973

Radiation Protection Division
Department of National Health and Welfare

The Radiation Protection Division of the Canadian Department of National Health and Welfare monitors surface air and precipitation in connection with its Radioactive Fallout Study Program. Twenty-four collection stations are located at airports (figure 4), where the sampling equipment is operated by personnel from the Meteorological Service Branch of the Department of Transport. Detailed discussions of the sampling procedures, methods of analysis, and interpretation of results of the radioactive fallout program are contained in reports of the Department of National Health and Welfare (*1–5*).

A summary of the sampling procedures and methods of analysis was presented in the May

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[3] Prepared from information and data obtained from the Canadian Department of National Health and Welfare, Ottawa, Canada.

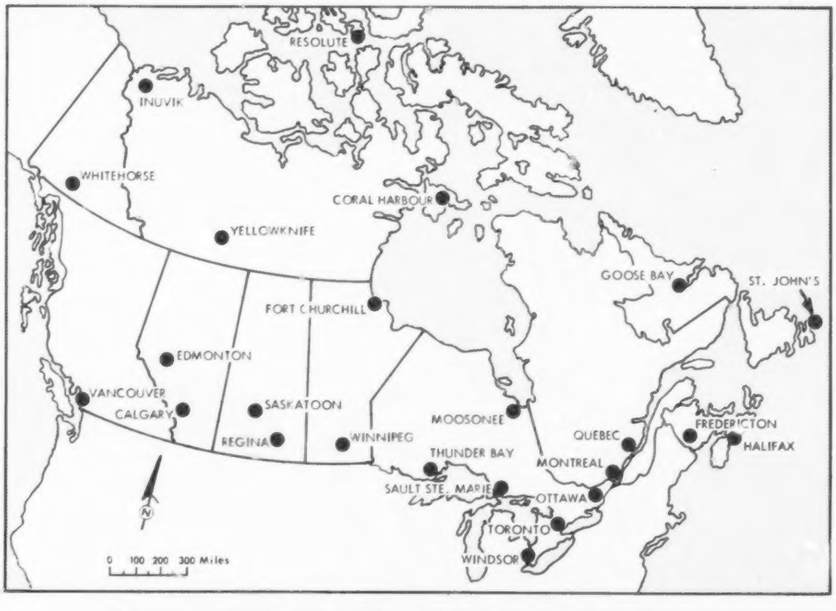
RESOLUTE
INUVIK
WHITEHORSE
CORAL HARBOUR
YELLOWKNIFE
GOOSE BAY
ST. JOHN'S
FORT CHURCHILL
EDMONTON
VANCOUVER
CALGARY
SASKATOON
REGINA
WINNIPEG
MOOSONEE
FREDERICTON
HALIFAX
QUEBEC
THUNDER BAY
MONTREAL
SAULT STE. MARIE
OTTAWA
TORONTO
WINDSOR
N
0 100 200 300 Miles

Figure 4. Canadian air and precipitation monitoring program

1969 issue of *Radiological Health Data and Reports.*

Surface air and precipitation data for May 1973 are presented in table 3.

Table 3. Canadian gross beta radioactivity in surface air and precipitation, May 1973

Station	Number of samples	Air surveillance gross beta radioactivity (pCi/m³)			Precipitation measurements	
		Maximum	Minimum	Average	Average concentration (pCi/liter)	Total deposition (nCi/m²)
Calgary	4	0.01	0.01	0.01	15	0.4
Coral Harbour	4	.02	.01	.01	15	.3
Edmonton	4	.02	.01	.01	16	.9
Ft. Churchill	4	.01	.01	.01	50	.3
Fredericton	4	.01	.01	.01	5	.5
Goose Bay	4	.01	<.01	.01	20	.7
Halifax	10	.02	.01	.01	21	.8
Inuvik	4	.02	.01	.01	22	.8
Montreal	4	.01	.01	.01	10	1.1
Moosonee	4	.03	.01	.02	NS	NS
Ottawa	3	.02	.01	.01	12	1.2
Quebec	4	.01	.01	.01	5	.9
Regina	4	.02	.01	.02	20	1.0
Resolute	4	.02	.01	.02	59	.1
St. John's, Nfld	2	.01	.01	.01	7	.9
Saskatoon	4	.02	.01	.02	23	.7
Sault Ste. Marie	4	.02	.01	.02	10	1.1
Thunder Bay	3	.01	.01	.01	18	.9
Toronto	4	.02	.01	.01	13	1.3
Vancover	4	.02	.01	.01	11	.5
Whitehorse	4	.01	.01	.01	26	.2
Windsor	4	.01	.01	.01	13	1.1
Winnipeg	4	.02	.02	.02	13	1.3
Yellowknife	3	.01	<.01	<.01	15	.2
Network summary	97	0.03	<0.01	0.01	18	0.7

NS, no sample available.

4. Pan American Air Sampling Program May 1973

Pan American Health Organization and U.S. Environmental Protection Agency

Gross beta radioactivity in air is monitored by countries in the Americas under the auspices of the collaborative program developed by the Pan American Health Organization (PAHO) and the Environmental Protection Agency (EPA) to assist PAHO-member countries in developing radiological health programs.

The air sampling station locations are shown in figure 5. Analytical techniques were described in the March 1968 issue of *Radiological Health Data and Reports.* The May 1973 air monitoring results from the participating countries are given in table 4.

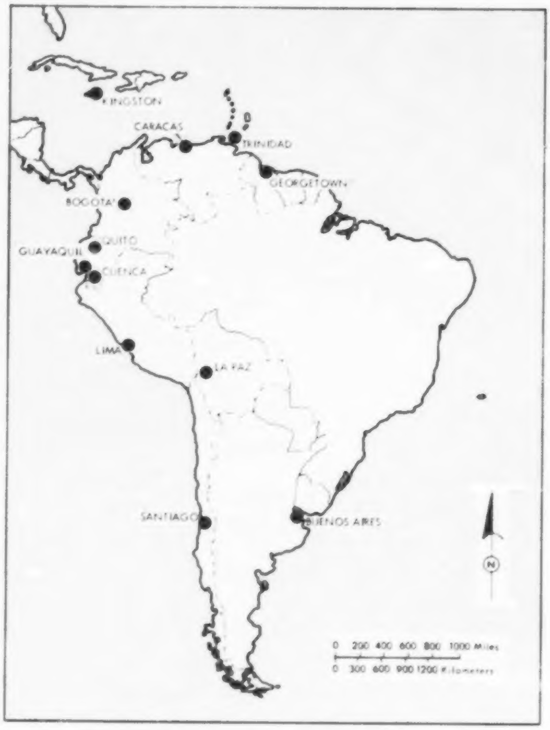

Figure 5. Pan American Air Sampling Program stations

Table 4. Summary of gross beta radioactivity in Pan American surface air, May 1973

Station location		Number of samples	Gross beta radioactivity (pCi/m³)		
			Maximum	Minimum	Average[a]
Argentina:	Buenos Aires	0			
Bolivia:	La Paz	11	0.01	0.01	0.01
Chile:	Santiago	28	.04	.00	.02
Colombia:	Bogota	21	.05	.00	.01
Ecuador:	Cuenca	8	.00	.00	.00
	Guayaquil	19	.02	.01	.01
	Quito	18	.00	.00	.00
Guyana:	Georgetown	0			
Jamaica:	Kingston	0			
Peru:	Lima	20	.05	.01	.02
Venezuela:	Caracas	11	.05	.00	.01
West Indies.	Trinidad	9	.07	.00	.06
Pan American summary		145	0.07	0.00	0.01

[a] The monthly average is calculated by weighting the individual samples with length of sampling period. Values less than 0.005 pCi/m³ are reported and used in averaging 0.00 pCi/m³.

5. California Air Sampling Program
May 1973

Bureau of Radiological Health
California State Department of Public Health

The Bureau of Radiological Health of the California State Department of Public Health with the assistance of several cooperating agencies and organizations operates a surveillance system for determining radioactivity in airborne particulates. The air sampling locations are shown in figure 6.

All air samples are sent to the Sanitation and Radiation Laboratory of the State Department of Public Health where they are analyzed for their radioactive content.

Airborne particles are collected by a continuous sampling of air filtered through a 47 millimeter membrane filter, 0.8 micron pore size, using a Gast air pump of about 2 cubic feet per minute capacity, or 81.5 cubic meters per day. Air volumes are measured with a direct reading gas meter. Filters are replaced every 24 hours except on holidays and weekends. The filters are analyzed for gross alpha and beta radioactivity 72 hours after the end of the collection period. The daily samples are then composited into a monthly sample for gamma spectroscopy and an analysis for strontium-89 and strontium-90. Table 5 presents the monthly gross beta radioactivity in air for May 1973. The monthly sample results are presented quarterly.

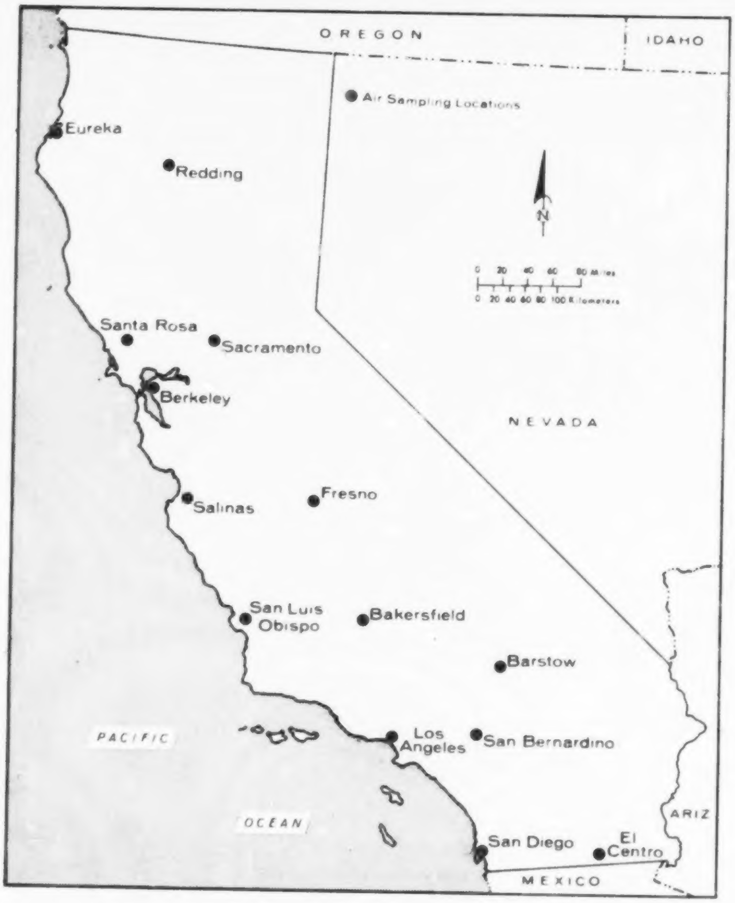
OREGON
IDAHO
● Air Sampling Locations
N
0 20 40 60 80 Miles
0 20 40 60 80 100 Kilometers
Eureka
Redding
Santa Rosa
Sacramento
Berkeley
NEVADA
Salinas
Fresno
San Luis Obispo
Bakersfield
Barstow
PACIFIC
Los Angeles
San Bernardino
OCEAN
ARIZ
San Diego
El Centro
MEXICO

Figure 6. California air sampling program stations

Table 5. Gross beta radioactivity in California air May 1973

Station location	Number of samples	Gross beta radioactivity (pCi/m³)		
		Maximum	Minimum	Average
Bakersfield	28	0.69	0.04	0.17
Barstow	31	.59	.00	.15
Berkeley	31	.09	.00	.04
El Centro	30	.79	.02	.13
Eureka	29	.09	.00	.03
Fresno	31	.96	.05	.17
Los Angeles	31	.14	.00	.05
Redding	29	.28	.03	.10
Sacramento	31	.35	.00	.10
Salinas	31	.95	.00	.14
San Bernardino	31	.45	.05	.10
San Diego	31	.07	.01	.05
San Luis Obispo	31	.50	.00	.12
Santa Rosa	29	.20	.00	.07
Summary	424	0.96	0.00	0.10

REFERENCES

(*1*) BIRD, P. M., A. H. BOOTH, and P. G. MAR. Annual report of 1959 on the Radioactive Fallout Study Program, CNHW–RP–3. Department of National Health and Welfare, Ottawa, Canada (May 1960).

(*2*) BIRD, P. M., A. H. BOOTH, and P. G. MAR. Annual report for 1960 on the Radioactive Fallout Study Program, CNHW–RP–4. Department of National Health and Welfare, Ottawa, Canada (December 1961).

(*3*) MAR, P. G. Annual report for 1961 on the Radioactive Fallout Study Program, CNHW–RP–5. Department of National Health and Welfare, Ottawa, Canada (December 1962).

(*4*) BEALE, J. and J. GORDON. The operation of the Radiation Protection Division Air Monitoring Program, RPD–11. Department of National Health and Welfare, Ottawa, Canada (July 1962).

(*5*) BOOTH, A. H. The calculation of permissible levels of fallout in air and water and their use in assessing the significance of 1961 levels in Canada, RPD–21. Department of National Health and Welfare, Ottawa, Canada (August 1962).

Surface Air Sampling Program—80th Meridian Network[1] January–December 1971

Health and Safety Laboratory
Atomic Energy Commission

The Health and Safety Laboratory (HASL), began its Surface Air Sampling Program in January 1963, as a continuation of the 80th Meridian Program conducted by the U.S. Naval Research Laboratory. The objective of this program is to study the spatial and temporal distribution of nuclear weapons debris and lead in the surface air.

The basic network consists of a line of sites approximately along the 80th meridian extending from about 81° N to 90° S latitudes (figure 1). Since 1963, a number of sites have been added to investigate the possible effects of longitude, elevation, and proximity to coastlines; and from late 1965 through March 1969, samplers were placed on four Atlantic Ocean weather ships to extend the surface air study over the marine environment (table 1).

Table 1. Station location

Site		Latitude	Longitude (west)	Elevation (meters)
Greenland	Nord	81° 40′ N	17° 00′	250
	Thule	76° 36′ N	68° 35′	259
Ontario:	Moosonee	51° 16′ N	80° 30′	10
N.Y:	New York City	40° 48′ N	73° 58′	38
Utah:	Salt Lake City	40° 46′ N	110° 49′	1,516
Va:	Sterling	38° 58′ N	77° 25′	76
Fla:	Miami	25° 49′ N	80° 17′	4
Bahamas:	Bimini	25° 46′ N	79° 22′	3
Hawaii:	Mauna Loa	19° 28′ N	155° 36′	3,401
P.R:	San Juan	18° 26′ N	66° 00′	10
Panama Canal Zone:	Balboa	8° 58′ N	79° 34′	23
Ecuador:	Guayaquil	2° 10′ S	79° 52′	7
Peru:	Lima	12° 01′ S	77° 08′	13
Bolivia:	Chacaltaya	16° 21′ S	68° 07′	5,220
Chile:	Antofagasta	23° 37′ S	70° 16′	31
	Isle de Pasqua	27° 10′ S	109° 26′	41
	Santaigo	33° 27′ S	70° 42′	520
	Puerto Montt	41° 27′ S	72° 57′	7
	Punta Arenas	53° 08′ S	70° 53′	35
Antarctica[a]		62° 56′ S	60° 36′	16
		64° 49′ S	62° 52′	10
South Pole Station		90° 00′ S		2,800

[a] The Chilean Antarctic station has moved at least three times within an area of about 2° latitude and longitude. For simplicity, the individual station names were dropped and all data grouped under "Antarctica."

Sampling and analytical procedures

Approximately 1,400 cubic meters of ambient air per day are drawn through an 8-inch diameter microsorban filter for the land stations. For the ocean stations, about 2,200 cubic meters of air per day were filtered by an 8- by 10-inch microsorban filter. Each filter is changed on the 1st, 8th, 15th, and 22nd of the month or more frequently if the filter becomes clogged with debris suspended in the air.

The filters are returned to HASL at the end of each month and under normal conditions, composited into monthly samples for analysis. Until late 1969, the composited sample was first gamma counted and then sent to a contractor laboratory for radiochemical analysis. In the current program, each sample is split into equal aliquots, one for gamma counting and spectrometry and the other for radiochemistry and stable lead analysis. Hence, half of each sample is now being kept and stored for possible future work.

Daily pump pressure drop and temperature readings also are submitted to HASL along with the samples for the purpose of computing the volume of sampled air.

Gamma analysis

The gamma activity of half of the monthly composites are obtained with an 8- by 4-inch sodium iodide (Tl) crystal as soon as possible after receipt of the samples. The integrated response between 100 keV and 3.0 MeV is corrected by the average detection efficiency (35 percent) of the gamma photons present in fallout; and the total gamma activities are reported in units of photons per minute per standard cubic meter.

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[1] Summarized from "Fallout Program Quarterly Summary Report," HASL 273 (April 1, 1973) available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22151.

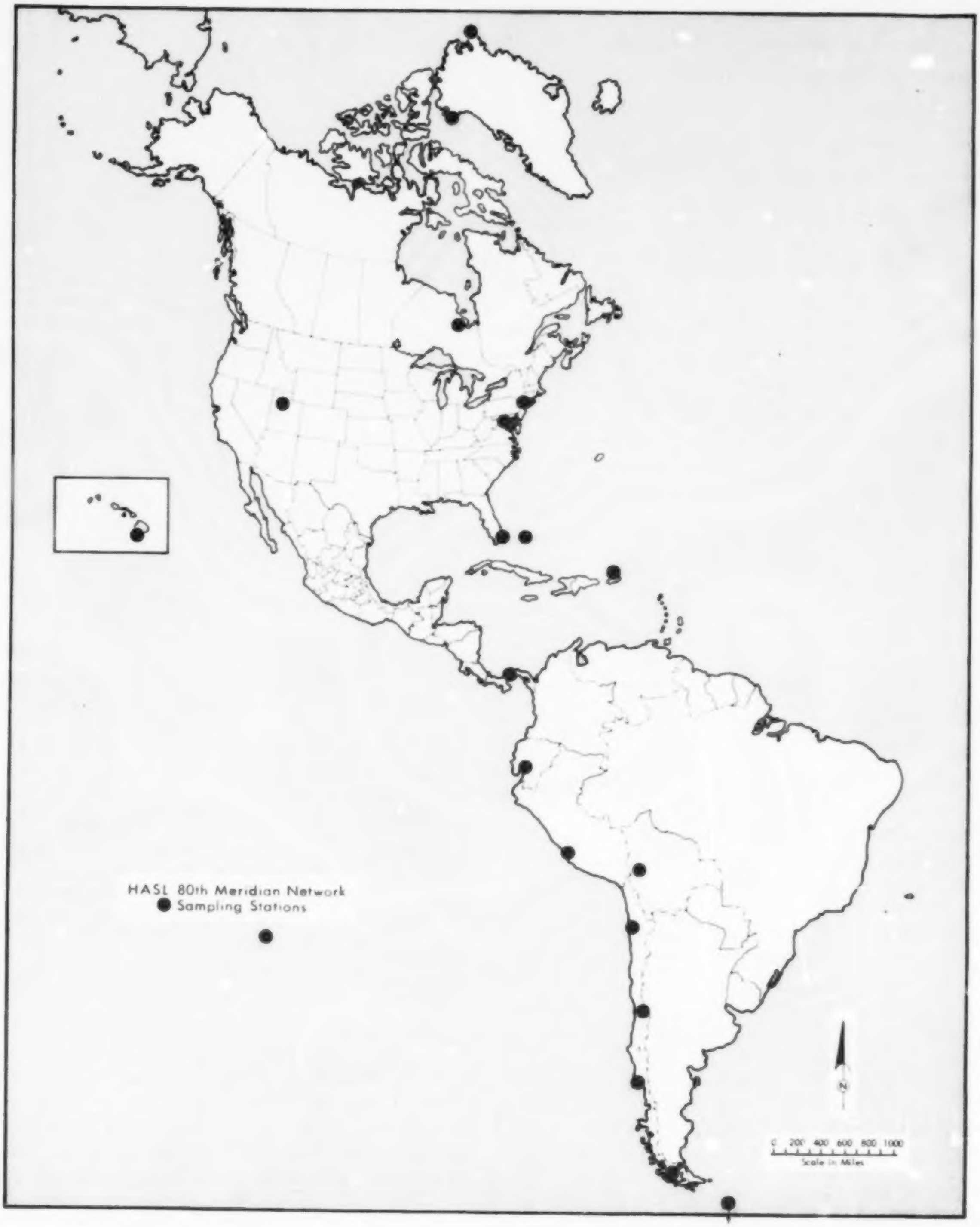
HASL 80th Meridian Network
● Sampling Stations
N
0 200 400 600 800 1000
Scale in Miles

Figure 1. HASL 80th Meridian Network sampling stations

Table 2. Strontium-89 concentrations in surface air, 1971[a]

Site		Concentration (fCi/m³)											
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Greenland:	Nord	1.04	9.28	5.06	12.5	9.4	8.6	4.89	2.59	0.83	1.07	[b]0.56	0.73
	Thule	3.49	—	21.8	29.9	19.1	20.1	10.7	4.98	1.45	1.89	1.43	3.41
Ontario:	Moosonee	1.79	1.91	10.7	18.5	31.1	25.9	14.0	7.95	2.55	1.87	—	—
N.Y:	New York City	4.35	16.4	12.0	16.1	34.5	32.7	20.8	10.5	3.19	1.06	.81	2.05
Utah:	Salt Lake City	10.1	9.01	28.8	56.8	65.3	55.5	28.9	8.26	4.09	1.75	6.21	10.3
Va:	Sterling	2.3	6.79	15.6	31.	38.8	22.6	15.4	7.61	2.02	1.12	[b].57	1.08
Fla:	Miami	8.02	15.5	29.1	42.1	38.3	15.1	11.7	3.56	2.96	.94	[b].59	—
Bahamas:	Bimini	5.8	26.	48.7	43.3	58.	16.6	13.1	3.97	3.72	2.42	6.43	—
Hawaii:	Mauna Loa	16.2	26.5	46.8	21.4	38.1	42.3	13.1	6.41	5.71	1.78	1.31	[b].76
P.R:	San Juan	5.83	16.5	28.5	—	—	—	—	—	—	—	[b].45	1.02
Panama Canal Zone:	Balboa	—	—	—	—	7.96	7.16	7.75	4.01	4.39	1.19	.44	.97
Ecuador:	Guayaquil	4.7	2.52	.84	1.24	[b].5	7.62	30.4	7.72	13.5	2.79	3.56	1.95
Peru:	Lima	14.6	8.65	8.64	—	4.15	42.0	187	88.6	106	62.6	52.2	45.1
Bolivia:	Chacaltaya	5.04	.84	[b]1.77	1.15	1.93	143	445	182	254	93.9	—	11.4
Chile:	Antofagasta	14.8	8.68	6.68	4.89	2.48	63.4	301	208	25.4	57.7	39.9	15.1
	Isle de Pasqua	—	—	5.26	1.51	.93	48.4	53.4	13.9	31.7	26.3	18.7	12
	Santiago	22.1	—	9.46	7.08	2.3	45	148	72.1	58.5	36	11.9	[b]3.38
	Puerto Montt	6.16	9.71	6.92	3.03	2.71	2.53	25.6	56.9	18.8	14.1	8.95	7.16
	Punta Arenas	1.42	3.27	3.03	—	.89	1.26	8.37	—	—	—	—	—
Antarctica		(c)	(c)	(c)	[b]49.8	[b]9.79	[b]5.51	10.2	[b]8.22	[b]4.42	[b]2.73	(c)	5.43
South Pole Station		4.52	17.3	[b]10.5	7.61	6.86	[b]1.28	3.15	9.15	10.9	10.1	10.4	18.6

[a] Errors are less than 20 percent except:
[b] Error between 20–100 percent;
[c] Error greater than 100 percent.
—, no data reported.

Table 3. Strontium-90 concentrations in surface air, 1971[a]

Site		Concentration (fCi/m³)											
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Greenland:	Nord	0.96	0.28	2.19	2.70	2.13	1.92	1.56	1.08	.48	.45	.83	.44
	Thule	2.01	2.27	4.65	4.83	3.31	2.64	3.54	2.32	1.03	.48	.92	1.32
Ontario:	Moosonee	1.07	.75	2.8	3.06	5.81	6.66	5.21	3.97	1.87	1.06	—	—
N.Y:	New York City	1.12	3.92	2.58	2.93	5.09	6.86	7.37	3.75	2.27	.62	.52	.81
Utah:	Salt Lake City	1.88	2.43	3.57	8.34	11.	11.6	7.74	4.11	3.21	1.49	1.09	1.55
Va:	Sterling	1.16	1.34	2.98	4.79	5.85	4.70	5.27	2.6	1.43	.57	.67	.88
Fla:	Miami	2.55	2.37	4.73	7.03	6.47	3.41	3.81	1.39	.63	.45	1.15	—
Bahamas:	Bimini	1.74	4.34	6.79	6.42	8.45	3.37	4.01	1.58	.99	1.21	4.47	—
Hawaii:	Mauna Loa	2.41	2.21	3.75	2.44	6.49	9.38	4.61	2.07	1.32	.91	.81	1.11
P.R:	San Juan	1.04	1.76	3.97	—	—	—	—	—	—	—	.46	.78
Panama Canal Zone:	Balboa	—	—	—	—	1.3	1.51	1.75	.66	.17	.08	[b].16	.58
Ecuador:	Guayaquil	.57	.35	.24	.34	.25	.19	.46	.29	.26	.1	.22	.21
Peru:	Lima	1.75	1.52	2.79	—	2.04	.92	2.25	2.58	2.44	2.31	2.36	4.15
Bolivia:	Chacaltaya	.55	.16	.42	.38	1.03	2.3	5.34	2.63	3.38	3.06	—	1.17
Chile:	Antofagasta	2.04	1.71	2.02	1.35	.94	1.74	4.51	4.12	.61	2.30	2.43	1.75
	Isle de Pasqua	—	—	1.06	.59	.41	.42	1.09	.55	1.33	1.47	1.54	1.19
	Santiago	2.81	—	2.57	3.44	1.28	1.46	2.91	2.57	2.11	1.86	1.09	1.17
	Puerto Montt	1.13	2.05	1.76	1.42	1.03	.64	.86	.73	.84	.70	.95	.87
	Punta Arenas	.48	.7	.88	—	.73	.53	.66	—	—	—	—	—
Antarctica		.64	.7	.57	.57	.49	.12	.39	.36	.32	.29	6.19	.46
South Pole Station		.99	1.92	1.31	1.49	1.12	.58	.67	.79	.89	1.04	1.18	3.25

[a] Errors are less than 20 percent except:
[b] Error between 20–100 percent.
—, no data reported.

Table 4. Zirconium-95 concentrations in surface air, 1971[a]

Site	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
	Concentration (fCi/m³)											
Greenland: Nord	2.57	5.46	19.1	—	25.9	25.3	19.2	8.41	4.1	[b] 4.43	[b] 2.95	—
Thule	6.05	11.8	22.6	49.5	—	40.8	34.5	15.6	6.87	[b] 3.85	3.47	[b] 1.73
Ontario: Moosonee	3.71	5.19	29.8	47.0	—	94.4	58.7	32.6	11.8	[b] 2.94	—	—
N.Y: New York City	4.58	11.1	37.7	53.6	92.1	92.3	67.9	39.4	—	6.05	2.51	2.04
Utah: Salt Lake City	14.6	—	89.2	181	226	168	[b] 77.8	[b] 29.8	9.3	14.6	3.99	2.16
Va: Sterling	6.01	—	38.3	—	116	71.4	57.8	26.2	8.54	4.62	([c])	2.08
Fla: Miami	20.6	46.1	111	125	—	62.0	34.3	11.7	8.7	[b] 6.77	[b] 7.83	—
Bahamas: Bimini	18.2	—	150	—	—	69.5	43.8	14.8	[b] 6.27	[b] 4.43	[b] 8.58	—
Hawaii: Mauna Loa	43.8	86.8	125	—	105	122	43.4	16.9	13.2	5.27	—	[b] 3.48
P.R: San Juan	14.7	38.3	87.5	—	—	—	—	—	—	—	[b] 4.95	2.64
Panama Canal Zone: Balboa	—	—	—	—	26.4	19.8	21.9	10.5	6.62	[b] 3.67	[b] .6	—
Ecuador: Guayaquil	13.9	11.0	[b] 2.89	4.62	[b] .54	27.1	77.9	28.7	—	53.7	40.6	24.4
Peru: Lima	46.6	31.0	—	—	17.2	97.1	311	139	192	—	103	86.7
Bolivia: Chalcaltaya	[b] 1.06	2.51	—	[b] 5.23	[b] 11.6	298	593	293	424	189	—	22.0
Chile: Antofagasta	44.2	—	25.3	—	8.63	115	471	261	97.1	126	89.3	46.6
Isle de Pasqua	—	—	[b] 15.7	—	[b] 1.81	65.9	96.6	34.1	53.9	47.9	37.3	22.6
Santiago	66.8	—	34.6	33.6	[b] 9.36	—	—	154	112	116	78.8	63.1
Puerto Montt	20.1	20.4	19.9	12.2	—	—	—	27.9	39.6	27.4	23.6	19.6
Punta Arenas	9.16	10.9	9.14	—	.57	—	13.5	—	—	—	—	—
Antarctica	[b] 278	[b] 29.7	[b] 43.6	([c])	([c])	—	[b] 11.8	—	7.85	11.0	3.98	5.91
South Pole Station	32.7	[b] 7.62	[b] 23.2	[b] 43.8	13.7	[b] 4.01	10.0	20	23.7	25.1	17.3	44.5

[a] Errors are less than 20 percent except:
[b] Error between 20–100 percent;
[c] Error greater than 100 percent.
—, no data reported.

Table 5. Cesium-137 concentrations in surface air, 1971[a]

Site	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
	Concentration (fCi/m³)											
Greenland: Nord	2.01	2.02	4.08	—	3.44	3.22	2.73	1.81	1.27	1.13	1.33	1.23
Thule	3.83	4.16	3.07	6.0	—	5.17	5.68	3.95	2.16	1.86	1.63	13.0
Ontario: Moosonee	2.46	1.6	4.92	5.65	—	12.0	8.91	6.78	3.86	1.84	—	—
N.Y: New York City	2.31	2.54	5.28	6.14	10.2	11.7	10.8	8.51	....	2.31	1.37	1.58
Utah: Salt Lake City	1.86	....	8.48	17.2	21.2	21.9	11.8	5.51	4.38	2.78	2.36	2.27
Va: Sterling	2.32	....	4.48	....	12.0	8.59	9.63	5.77	2.43	1.51	1.32	1.61
Fla: Miami	5.14	6.8	10.3	12.1	....	6.89	5.65	2.33	1.56	.98	2.67	....
Bahamas: Bimini	5.11	....	14.2	....	....	8.31	6.5	3.1	[b] 2.11	[b] 2.01	4.94	....
Hawaii: Mauna Loa	4.78	5.97	8.43	....	9.16	13.9	7.21	3.46	2.21	1.92	[b] 1.31	[b] 1.79
P.R: San Juan	2.35	3.1	7.54	—	—	—	—	—	—	—	[b] .87	1.59
Panama Canal Zone: Balboa	—	—	—	—	2.24	2.68	2.84	1.27	([c])	[b] .26	([c])	[b] .93
Ecuador: Guayaquil	1.02	.91	[b] .43	.72	[b] .40	.59	.95	.7	—	1.0	2.2	1.74
Peru: Lima	3.69	3.22	—	—	4.03	2.03	3.67	3.51	4.59	—	5.41	6.1[illegible]
Bolivia: Chacaltaya	.79	.26	[b] .68	.56	1.64	4.44	6.69	[b] 3.43	6.53	5.07	—	—
Chile: Antofagasta	4.24	—	[b] .34	—	1.8	3.25	6.99	7.53	2.52	5.59	5.67	4.37
Isle de Pasqua	—	—	1.91	.75	.64	.95	1.65	.99	2.1	1.81	2.54	1.69
Santiago	6.55	—	4.96	5.74	2.22	—	—	5.59	3.54	4.18	4.09	4.87
Puerto Montt	2.24	2.15	2.93	2.44	—	—	—	1.13	1.32	[b] 1.66	1.75	1.82
Punta Arenas	1.00	1.37	1.21	—	.95	—	.86	—	—	—	—	—
Antarctica	[b] 1.59	.94	([c])	.74	.59	[b] .27	.49	—	.67	.47	[b] .63	.8
South Pole Station	3.45	3.55	2.98	2.85	2.31	1.1	1.35	1.53	1.48	2.01	1.6	5.19

[a] Errors are less than 20 percent except:
[b] Error between 20–100 percent;
[c] Error greater than 100 percent.
—, no data reported.

Table 6. Cerium-144 concentrations in surface air, 1971[a]

Site	Concentration (fCi/m³)											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Greenland: Nord	13.1	15.1	29.7	—	32.9	37.5	33.2	19.3	13.5	10.5	11.1	8.55
Thule	26.9	27.8	28.2	60.0	—	62.4	67.1	45.	20.8	18.7	14.2	7.72
Ontario: Moosonee	15.7	11.1	40.9	53.5	—	144	105	85.3	35.1	17.9	—	—
N.Y: New York City	16.3	18.5	44.8	59.1	112	132	128	91.6	—	21.4	11.0	11.3
Utah: Salt Lake City	15.6	—	84.1	191	256	282	152	69.5	44.6	28.9	17.6	16.7
Va: Sterling	17.4	—	46.5	—	144	106	110	63.	26.4	17.6	9.68	13.3
Fla: Miami	36.3	58.9	103	132	—	88.9	63.2	27.6	18.7	9.84	21.5	—
Bahamas: Bimini	36.8	—	136	—	—	100	86.4	32.2	26.8	16.7	38.9	—
Hawaii: Mauna Loa	38.4	57.6	99.9	—	116	172	81.1	35.5	24.0	13.5	12.8	17.1
P.R: San Juan	19.0	31.5	76.9	—	—	—	—	—	—	—	9.84	12.3
Panama												
Canal Zone: Balboa	—	—	—	—	29.4	30.5	36.1	16.8	3.88	2.77	[b]4.69	9.44
Ecuador: Guayaquil	13.9	9.97	4.51	7.47	4.27	7.93	19.3	11.2	—	23.5	27.9	20.9
Peru: Lima	44.0	35.5	—	—	37.5	29.1	80.2	58.0	67.5	—	76.0	87.7
Bolivia: Chacaltaya	9.84	2.82	7.75	6.06	15.0	75.5	152	80.6	132	87.4	—	23.5
Chile: Antofagasta	45.3	—	—	—	15.4	39.5	130	122	43.6	72.6	61.3	47.7
Isle de Pasqua	—	—	20.1	10.5	6.64	18.9	28.8	13.7	27.7	25.6	27.8	20.6
Santiago	67.4	—	52.1	59.8	22.0	—	—	65.2	52.0	65.1	63.7	66.1
Puerto Montt	20.4	24.5	29.8	25.8	—	—	—	16.3	19.3	19.4	21.5	18.7
Punta Arenas	10.3	13.6	13.8	—	8.52	—	10.2	—	—	—	—	—
Antarctica	18.7	8.3	8.74	6.92	6.31	2.66	5.77	6.25	5.52	6.47	4.57	9.39
South Pole Station	33.3	37.0	30.7	30.8	24.5	11.4	12.4	15.7	16.2	22.8	19.5	52.2

[a] Errors are less than 20 percent except:
[b] Error between 20-100 percent.
—, no data reported.

Table 7. Plutonium-238 concentrations in surface air, 1971[a]

Site	Concentration (aCi/m³)											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Greenland: Nord	[b]5.73	[b]4.09	[b]4.17	[b]5.73	[b]5.88	[b]4.04	[b]1.4	[b]3.56	[b]1.19	[b]1.41	(c)	(c)
Thule	[b]7.51	8.09	8.72	7.79	[b]6.72	[b]3.17	[b]3.02	[b]1.63	(c)	1	[b]4.31	(c)
Ontario: Moosonee	[b]2.15	[b]1.47	[b]4.20	15.4	[b]6.52	7.46	[b]5.77	(c)	[b]3.24	(c)	—	—
N.Y: New York City	20.6	103	27.8	9.24	11.2	10.3	10.1	14.9	5.88	3.50	3.24	5.1
Utah: Salt Lake City	[b]6.89	[b]4.49	8.94	14.1	13.5	10.8	8.26	[b]4.43	[b]3.77	[b]2.22	[b]2.11	[b]2.37
Va: Sterling	[b]1.55	6.72	6.18	[b]3.83	10.3	[b]4.24	[b]2.84	[b]3.26	(c)	(c)	[b]1.95	(c)
Fla: Miami	[b]8.19	7.66	11.7	16.5	7.52	[b]5.45	[b]2.86	[b]3.61	(c)	(c)	(c)	—
Bahamas: Bimini	9.21	9.5	10.6	9.57	17.1	[b]7.53	[b]2.49	7.75	(c)	[b]3.77	(c)	—
Hawaii: Mauna Loa	[b]12.4	7.4	[b]4.62	36.7	25.4	16.6	12.1	9.9	[b]8.23	[b]2.15	[b]2.22	(c)
P.R: San Juan	[b]4.55	5.46	[b]9.31	—	—	—	—	—	—	—	[b]3.12	(c)
Panama												
Canal Zone: Balboa	—	—	—	—	[b]2.2	[b]5.70	[b]1.44	[b]3.35	[b]2.07	(c)	(c)	(c)
Ecuador: Guayaquil	[b]4.77	[b]1.84	(c)	[b]2.60	[b]2.82	[b]2.35	[b]4.39	[b]1.64	[b]2.85	[b]3.08	(c)	(c)
Peru: Lima	8.53	7.53	[b]8.87	—	[b]4.35	8.77	11.4	11.3	4.35	[b]4.44	[b]9.29	[b]4.63
Bolivia: Chacaltaya	11.6	[b]2.38	[b]1.72	235	[b]1.6	[b]15.8	10.1	[b]7.68	[b]4.14	[b]6.81	—	(c)
Chile: Antofagasta	12.0	[b]6.33	[b]3.40	[b]5.11	[b]4.4	18.7	22.4	12.6	[b]2.09	[b]5.29	[b]2.33	[b]2.10
Isle de Pasqua	—	—	[b]4.20	[b]3.14	[b]3.26	[b]2.54	[b]3.68	[b]2.71	4.65	[b]3.44	[b]2.78	(c)
Santiago	17.2	—	7.38	[b]10.4	6.62	[b]10.3	8.72	[b]9.85	[b]4.53	7.94	5.91	[b]2.55
Puerto Montt	(c)	[b]4.44	5.17	[b]3.27	[b]2.60	16.2	7.23	[b]2.73	[b]3.12	(c)	[b]2.25	[b]2.02
Punta Arenas	4.97	[b]5.45	[b]6.05	—	[b]1.88	[b]4.12	15.6	—	—	—	—	—
Antarctica	(c)	(c)	[b]1.76	[b]1.87	[b]1.15	(c)	[b]2.61	[b]1.26	[b]3.51	(c)	(c)	(c)
South Pole Station	8.32	23.7	[b]4.77	[b]7.51	[b]2.7	—	[b]2.75	[b]5.34	7.43	10.4	[b]4.55	[b]3.79

[a] Errors are less than 20 percent except:
[b] Error between 20-100 percent;
[c] Error greater than 100 percent.
—, no data reported.

Table 8. Plutonium-239 concentrations in air, 1971[a]

Site		Concentration (aCi/m³)											
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Greenland:	Nord	18.5	22.6	31.1	44.1	34.2	35.3	28.3	16.7	14.5	12.4	[b] 17.0	11.9
	Thule	34.1	40.7	83.5	93.1	62.3	50.8	67.1	39.7	14.0	—	18.9	20.8
Ontario:	Moosonee	20.6	14.7	46.2	71.2	100	126	98.4	53.7	33.8	21.6	—	—
N.Y:	New York City	26.6	22.3	44.4	59.3	111	133	135	92.6	38.3	25.6	14.2	16.2
Utah:	Salt Lake City	31.8	47.4	83.9	203	238	315	154	88.9	60.7	37.0	32.9	33.5
Va:	Sterling	22.6	30.9	52.0	81.4	118	84.2	100	57.0	27.7	19.0	18.6	17.7
Fla:	Miami	53.6	67.2	106	142	125	76.4	67.7	25.2	17.4	7.94	22.7	—
Bahamas:	Bimini	50.8	81.3	136	137	168	87.5	79.9	33.1	20.3	20.8	59.9	—
Hawaii:	Mauna Loa	[b] 43.3	47.4	69.0	38.4	110	162	80.5	39.8	22.3	20.8	20.2	18.8
P.R:	San Juan	26.7	32.0	57.9	—	—	—	—	—	—	—	9.52	15.8
Panama Canal Zone:	Balboa	—	—	—	—	22.4	33.3	30.8	13.0	[b] 1.82	[b] .81	[b] 3.63	13.0
Ecuador:	Guayaquil	29.2	8.1	[b] 3.27	5.66	[b] 6.36	15.3	58.1	5.11	6.67	14.0	18.9	7.75
Peru:	Lima	35.2	36.5	36.8	—	52.6	68.9	143	56.3	29.8	40.8	36.7	48.5
Bolivia:	Chacaltaya	10.5	[b] 1.64	[b] 4.25	[b] 11.7	[b] 5.88	190	78.9	25.5	50.7	36.7	—	[b] 7.11
Chile:	Antofagasta	37.0	42.6	28.2	22.7	23.2	55.4	213	70.4	16.1	32.6	26.7	23.6
	Isle de Pasqua	—	—	[illegible]	8.39	7.13	19.9	45.6	8.03	15.8	13.3	14.1	12.9
	Santiago	55.4	—	[illegible]	50.9	18.2	80.8	55.8	61.5	27.4	32.7	23.6	24.3
	Puerto Montt	[b] 71.5	24.1	[illegible]	17.2	19.3	25.3	23.8	12.2	11.6	[b] 18.6	11.0	12.9
	Punta Arenas	11.3	12.5	[b] 16.8	—	10.3	11.4	11.3	—	—	—	—	—
Antarctica		16.2	11.3	8.89	8.91	7.97	3.56	13.0	6.79	4.30	4.48	4.18	8.69
South Pole Station		30.4	39.3	29.3	26.4	22.3	—	16.9	14.9	16.3	15.5	16.1	36.8

[a] Errors are less than 20 percent except:
[b] Errors between 20–100 percent.
—, no data reported.

Gamma spectra of the monthly composites are obtained using a lithium-drifted germanium diode (GeLi) system. Concentrations of the gamma emitting nuclides, beryllium-7, zirconium-95, cesium-137, and cerium-144 are determined by computer resolution of the spectra. Beginning in June 1970, all results from these nuclides, reported in the tables were obtained using this system.

Radiochemical analyses

The other halves of the monthly composites are sent to a contractor laboratory for radiochemical analyses.

There was no major weapon test series from the end of 1962 until May 1966. Consequently only the longer lived artificially produced radionuclides were present in the filters collected during this period and emphasis was given to the determination of manganese-54, iron-55, strontium-90, cadmium-109, cesium-137, cerium-144, plutonium-238, and plutonium-239. In samples collected after French or Chinese atmospheric weapons tests additional short-lived nuclides were analyzed, such as strontium-89, zirconium-95, and cerium-141.

The longer-lived fission products and plutonium-239 concentrations should describe the general distribution in surface air in all previous nuclear weapon debris which was transferred from the lower stratosphere to the troposphere during the collection period of this report. Other tracer nuclides can be associated with debris from a single detonation or series of detonations. Manganese-54 and iron-55 were produced in large quantities in the 1961 and 1962 test series. Cadmium-109 was generated by the U.S. high altitude test over Johnston Island on July 9, 1962. While plutonium-238 is present in low concentrations in nuclear weapons debris, about 17,000 curies of plutonium-238 was disseminated at high altitude in the stratosphere on April 21, 1964 during the reentry burnup of a SNAP-9A power source.

As the levels of any of the radionuclides drop to below practical detection limits they are eliminated from the radiochemical program; thus cadmium-109 was not analyzed after the end of 1967.

In response to the growing concern over air pollution and in particular to the known hazard linked to stable lead, analysis for this element was added to the program.

Most of the analyses of surface air samples were carried out from July 1969 to the present by the LFE-Environmental Analysis Laboratories.

Results

The radioactivity concentrations in surface air during January–December 1971 are presented in tables 2 through 8. The sites are listed according to latitude beginning with the most northern site at Nord, Greenland (table 1).

The concentrations are reported at the midpoint of the collection month for the plutonium isotopes and the fission products.

One standard deviation of the counting error for these data is always less than ±20 percent unless otherwise indicated.

Recent coverage in *Radiation Data and Reports:*

Period	Issue
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SECTION IV. OTHER DATA

This section presents results from routine sampling of biological materials and other media not reported in the previous sections. Included here are such data as those obtained from human bone sampling, Alaskan surveillance, and environmental monitoring around nuclear facilities.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission (AEC) receives from its contractors annual reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant environmental surveys are required.

Releases of radioactive materials from AEC installations are governed by radiation standards set forth by AEC's Division of Operational Safety in directives published in the "AEC Manual."[1]

A summary of the environmental radioactivity data follows for the Feed Materials Production Center.

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[1] Title 10, Code to Federal Regulations, Part 20, "Standards for Protection Against Radiation" contains essentially the standards published in Chapter 0524 of the AEC Manual.

1. Feed Materials Production Center[2]
January–December 1971

National Lead Company
Fernald, Ohio

The Feed Materials Production Center (FMPC) is operated by the National Lead Company of Ohio for the Atomic Energy Commission (AEC). The location as related to populated areas is shown in figure 1. Cincinnati and Hamilton, the larger nearby communities, are situated 20 and 10 miles from the center, respectively.

The primary work at the FMPC is the production of purified uranium metal and compounds for use at other AEC sites. A small amount of thorium is also processed.

Uranium production may begin with ore concentrates, recycled uranium from spent reactor fuel, or with various compounds from other AEC sites. Impure starting material is dissolved in nitric acid and the uranium is extracted into an organic liquid and then back-extracted into dilute nitric acid to yield a solution of uranyl nitrate hexahydrate.

Evaporation and heating convert the nitrate solution to uranium trioxide (UO_3) powder. This compound is reduced to uranium dioxide (UO_2) with hydrogen and then converted to uranium tetrafluoride (UF_4) by reaction with anhydrous hydrogen fluoride. Uranium metal is produced by reacting UF_4 and magnesium metal in a refractory-lined vessel. This primary uranium metal is then remelted with scrap uranium metal to yield a purified uranium ingot which is rolled or extruded to form rods or tubes. Sections are then cut and machined to final dimensions. These machined cores are then shipped to other AEC sites for canning and final assembly into reactor fuel elements.

Thorium production steps, in general, are similar to those followed in uranium produc-

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[2] Summarized from Environmental Monitoring at Major U.S. Atomic Energy Commission Contractor Sites; Feeds Material Production Center, 1971.

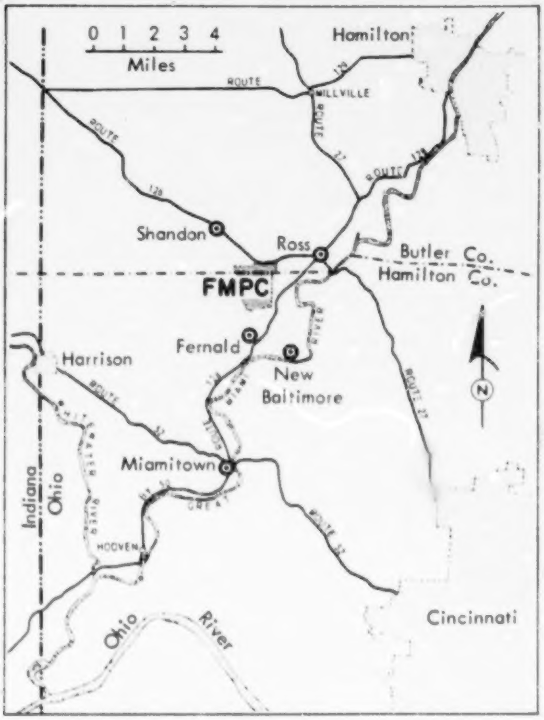
0 1 2 3 4
Miles
Hamilton
Route
Millville
Route 27
Route 128
Route 128
Shandon
Ross
Butler Co.
Hamilton Co.
FMPC
Fernald
New Baltimore
Harrison
Route
Miamitown
Indiana
Ohio
Hooven
Great
Route 27
Route 27
Cincinnati
Ohio River

Figure 1. Area map of Feed Materials Production Center

tion. Final products may be purified thorium nitrate solution, solid thorium compounds, or metal.

Air monitoring

Conversion of impure uranium and thorium compounds to reactor-grade feed materials involves operations which generate radioactive dust, nuisance dusts, and corrosive mists of reaction products. Ventilation and air cleaning systems are used to confine this air and remove airborne contaminants, including valuable material which is returned to the production process. The filtered or scrubbed air is exhausted to the atmosphere. Sampling of these stack exhausts is maintained on a continuous schedule to monitor the operating condition of the air cleaning systems.

To determine the concentration of material which might reach the offsite air, samples were collected continuously at four locations around the production area and at the sewage treatment plant (STP) (figure 2). At each location a metered quantity of air was drawn through a filter which was changed weekly. Each filter and its collection of dust was dissolved and the solution analyzed for uranium and alpha and beta radioactivity. After these analyses, the remaining solutions were saved and composited for thorium analysis. Frequent analyses for thorium are not considered necessary because of the small amount of thorium processed.

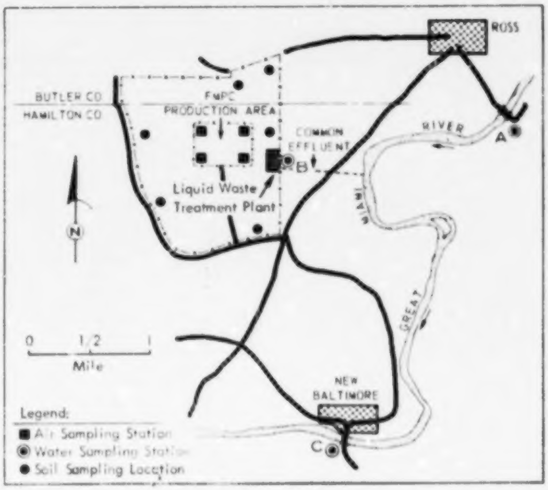
ROSS
BUTLER CO
HAMILTON CO
FMPC
PRODUCTION AREA
COMMON EFFLUENT
RIVER
A
B
Liquid Waste Treatment Plant
MIAMI
GREAT
N
0 1/2 1
Mile
NEW BALTIMORE
C
Legend:
■ Air Sampling Station
◉ Water Sampling Station
● Soil Sampling Location

Figure 2. Air, water, and soil sampling stations, FMPC

During 1971, the only routine analysis made for nonradioactive contaminants was the determination of particulate matter. Filters used at the five sampling locations mentioned above plus one test adapter sampler at location (E) were weighed before use and then reweighed after changing to obtain the weight of collected dust.

A new air sampling schedule was started in January 1972, and includes occasional boundary sampling for oxides of nitrogen and sulfur dioxide. Occasional grab sampling for nitrogen oxide near the production area has shown that the concentration of this chemical is well within EPA limits but the boundary sampling will be carried out to provide documentation.

Data in table 1 show that the average radionuclide concentrations in air, at the onsite sampling stations, were no greater than 2 percent of their respective standards for offsite areas. It is concluded from these data that any offsite radiation exposure resulting from FMPC air-

Table 1. Radioactivity levels of airborne particulates, Feed Materials Production Center, January-December 1971

Location	Number of samples	Uranium concentration[a] (pCi/m³)			Alpha radioactivity[a] (pCi/m³)			Beta radioactivity[b] (pCi/m³)			Number of samples	Thorium concentrations[c] (pCi/m³)		
		Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average		Maximum	Minimum	Average
Southwest	50	0.37	<0.01	0.04	0.28	<0.001	0.04	0.43	0.04	0.16	6	0.58	0.18	0.39
Northwest	48	.13	<.01	.03	.14	<.001	.03	.52	.02	.16	6	.65	.10	.25
Northeast	52	.11	<.01	.03	.08	<.001	.03	.55	.03	.14	6	.66	.12	.30
Southeast	49	.20	<.01	.03	.15	<.001	.03	.49	.02	.15	6	.39	.08	.25
Sewage treatment plant	43	.11	<.01	.02	.15	<.001	.02	.60	.04	.15				

[a] AEC radiation protection standard—2 pCi/m³ (natural uranium).
[b] AEC radiation protection standard—1 nCi/m³ (thorium-234).
[c] AEC radiation protection standard—1 pCi/m³ (natural thorium).

Table 2. Particulate matter in air, Feed Material Production Center, January–December 1971

Location	Number of samples	Concentration (μg/m³)			Percent of standard	95-percent confidence level	Detection level	Standard[a]
		Maximum	Minimum	Average				
Southwest	7	57	28	46	61	± 5	1 μg/m³	75 μg/m³
Northwest	5	70	37	57	76			
Northeast	6	77	46	64	85			
Southeast	4	64	38	55	73			
Sewage treatment plant	4	89	32	55	73			

[a] Environmental Protection Agency. Code of Federal Regulations, Title 42, Part 410, National Primary and Secondary Ambient Air Quality Standards, *Federal Register*, No. 84. April 30, 1971.

borne contaminants would be a small fraction (< 1 percent) of the AEC standards

The average concentrations of airborne particulate matter, given in table 2, are below the EPA standard. The highest average (Northeast) may have been due to the contribution from the nearby boiler plant.

Water monitoring

Each of the individual production plants on the project has collection sumps and treatment equipment for the initial treatment of process waste water. Uranium and thorium may be recovered as part of the treatment. Effluents from the plants are collected at a central facility, called the "general sump", for additional treatment. The treated wastes are then discharged into a large pit where the solids settle to the bottom. Clear effluent from the pit is combined with the other water streams and discharged to the Great Miami River.

Water samples are collected at several points to determine the effect of the effluent upon the river (figure 2). At point A, upstream from the effluent discharge, a weekly river water spot sample is taken for background analysis. At the final access point on the waste liquid line, a Parshal Flume-type water sampler collects a sample continuously which is proportional to the total flow. This sample is collected and analyzed on a daily basis. Results of this analysis, combined with daily river flow measurements, are used to calculate contaminant concentrations added to the river at point B. At point C, downstream on the river from the discharge point, 24-hour samples are collected by a continuous sampler. At least one sample is analyzed each week.

Samples from all collection points are analyzed for uranium, alpha, and beta radioactivity, radium-226, radium-228, chloride, fluoride, nitrate, filterable solids, and pH. Results of this monitoring have been reported to the Ohio Department of Health on a monthly basis since 1954.

Individual samples may be analyzed for other contaminants or they may be composited for varying periods and analyzed for lesser contaminants such as thorium.

Table 3 contains information on radionu-

Table 3. Radioactivity contaminants in water, Feeds Material Production Center, January–December 1971

Radionuclide	Sampling Location[a]	Number of samples	Concentration (pCi/liter)		
			Maximum	Minimum	Average
Uranium[b]	A	55	20	<1	3
	B	365	182	<1	2
	C	56	6	<1	2
Thorium[b]	B	[c] 12	.009	.0009	.00112
Radium-226	A	6	.908	<.445	.445
	B	15	.139	.004	.062
	C	6	.908	<.445	.445
Radium-228	A	12	.908	<.445	.445
	B	24	.058	<.002	.015
	C	12	.908	<.445	.445
Dissolved alpha	B	60	1.52	.161	.368
Gross beta	A	55	54	4	20
	B	365	921	<1	38
	C	56	45	9	18

[a] A, Miami River upstream at Ross, Ohio; B, calculated addition to the river based on effluent analyses and river flow; C, Miami River, downstream at New Baltimore, Ohio.

[b] In accordance with AEC Manual, a curie of natural uranium means a total of 7.49×10^{10} dps, and a curie of natural thorium means a total of 7.4×10^{10} dps.

[c] Each sample covers a 1-month period.

clides in water. As shown, the average concentrations of uranium, thorium, and radium added to the river was <1 percent of the AEC Radiation Protection Standards. The average upstream concentrations of radium-228 were 3.0 percent and 1.5 percent of the standard for uncontrolled areas. Although both radionuclides were present in the plant effluent, the average downstream concentrations were no higher than those found upstream.

As shown in table 3, the State criteria for gross beta and dissolved alpha radioactivity were not exceeded in the river. The calculated addition of dissolved gross alpha did average 12.3 percent of the State criteria. However, this alpha activity was due principally to uranium, for which the AEC limit is substantially higher. The more limiting State standard is intended to provide control over all alpha emitters, including radium-226 which must be kept at a concentration much lower than other less important radionuclides.

Soil monitoring

At least once each year, soil samples are collected at six locations inside the project boundary (figure 2). Each sample consists of six cores, 2 cm in diameter and 10 cm deep. The cores are taken about 1.5 meters apart. These samples are analyzed for uranium to observe the possible contribution from stack effluents.

There are no standards for comparison with the results for uranium in soil listed in table 4. The higher result is due to the localized contribution from the small onsite incinerator. Although the normal values for uranium in local soil is 1-4 μg/g, there are no hazards associated with the elevated soil uranium produced by FMPC operations. External radiation from uranium is slight and the exposure contribution from these onsite concentrations would be considerably less than 1 percent of the radiation protection standard for people in uncontrolled areas.

Table 4. Uranium in soil—onsite locations, Feed Materials Production Center, January–December 1971

Sampling point[a]	Number of samples	Uranium concentration			Detection level
		pCi/g (dry weight)	μg/g	95-percent confidence level	
1	1	2.2	10.1	±25 percent	0.5 μg/g
2	1	4.4	19.9		
3	2	21.3	95.8		
4	1	2.0	8.9		
5	1	3.8	17.0		
6	1	4.0	18.2		

[a] See sampling locations shown in figure 2.

Nuclear Power Reactors in the United States
June 30, 1973

Each quarter year, the Atomic Energy Commission releases information on the status of all present and proposed civilian nuclear power generating units in the United States. This information is reproduced for interested readers of *Radiation Data and Reports.*

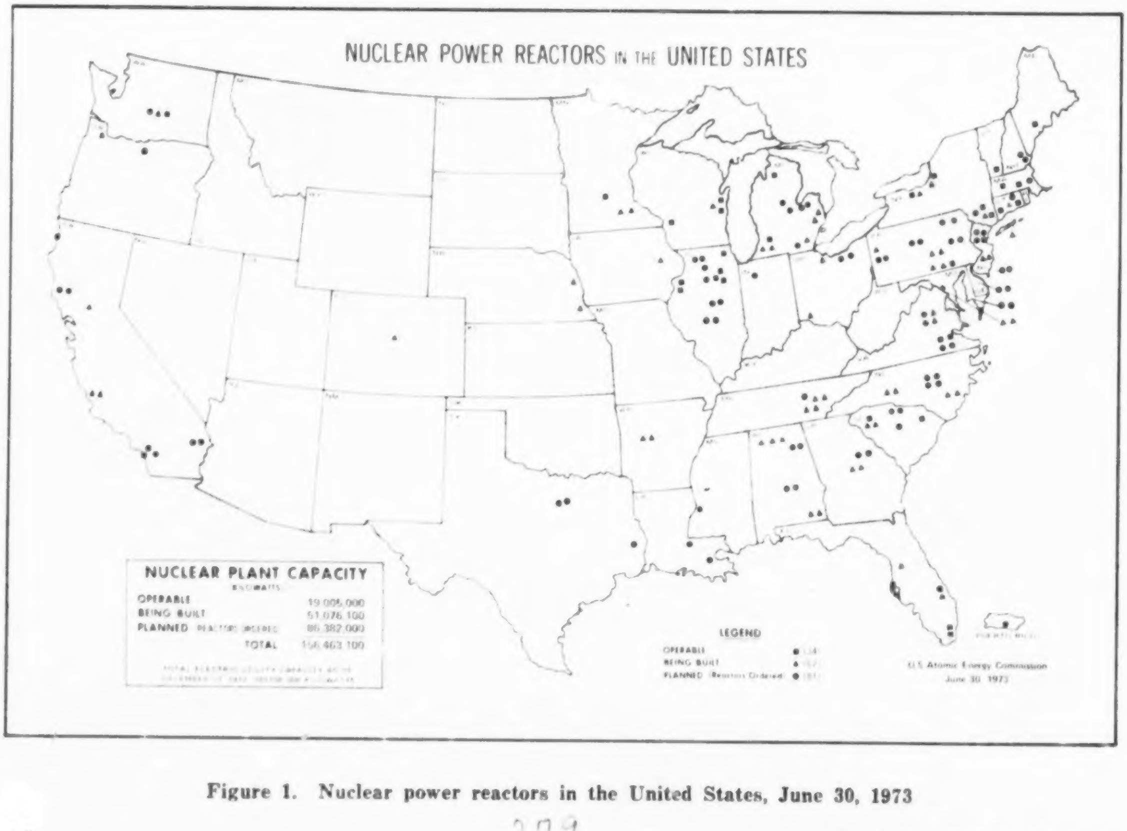
NUCLEAR POWER REACTORS IN THE UNITED STATES
NUCLEAR PLANT CAPACITY
KILOWATTS
OPERABLE 19,005,000
BEING BUILT 51,076,100
PLANNED REACTORS ORDERED 86,382,000
TOTAL 156,463,100
LEGEND
OPERABLE ●
BEING BUILT ▲
PLANNED (Reactors Ordered) ●
PUERTO RICO
U.S. Atomic Energy Commission
June 30, 1973

Figure 1. Nuclear power reactors in the United States, June 30, 1973

SITE	PLANT NAME	CAPACITY (Net Kilowatts)	UTILITY	COMMERCIAL OPERATION
ALABAMA				
Decatur	Browns Ferry Nuclear Power Plant Unit 1	1,065,000	Tennessee Valley Authority	1973
Decatur	Browns Ferry Nuclear Power Plant Unit 2	1,065,000	Tennessee Valley Authority	1974
Decatur	Browns Ferry Nuclear Power Plant Unit 3	1,065,000	Tennessee Valley Authority	1974
Dothan	Joseph M. Farley Nuclear Plant Unit 1	829,000	Alabama Power Co	1975
Dothan	Joseph M. Farley Nuclear Plant Unit 2	829,000	Alabama Power Co	1977
Orville	Central Alabama Nuclear Plant	1,100,000	Alabama Power Co	1980
Orville	Central Alabama Nuclear Plant	1,100,000	Alabama Power Co	1981
Scottsboro	Bellefonte Nuclear Plant Unit 1	1,189,000	Tennessee Valley Authority	1979
Scottsboro	Bellefonte Nuclear Plant Unit 2	1,189,000	Tennessee Valley Authority	1980
ARKANSAS				
Russellville	Arkansas Nuclear One Unit 1	820,000	Arkansas Power & Light Co.	1973
Russellville	Arkansas Nuclear One Unit 2	902,000	Arkansas Power & Light Co	1976
CALIFORNIA				
Humboldt Bay	Humboldt Bay Power Plant Unit 3	68,500	Pacific Gas and Electric Co	1963
San Clemente	San Onofre Nuclear Generating Station Unit 1	430,000	So. Calif. Ed. & San Diego Gas & El. Co	1968
San Clemente	San Onofre Nuclear Generating Station Unit 2	1,140,000	So. Calif. Ed. & San Diego Gas & El. Co	1978
San Clemente	San Onofre Nuclear Generating Station Unit 3	1,140,000	So. Calif. Ed. & San Diego Gas & El. Co	1979
Diablo Canyon	Diablo Canyon Nuclear Power Plant Unit 1	1,060,000	Pacific Gas and Electric Co	1975
Diablo Canyon	Diablo Canyon Nuclear Power Plant Unit 2	1,060,000	Pacific Gas and Electric Co.	1976
Clay Station	Rancho Seco Nuclear Generating Station	804,000	Sacramento Municipal Utility District	1974
Pt. Arena	Mendocino Power Plant Unit 1	1,128,000	Pacific Gas & Electric Co	1981
Pt. Arena	Mendocino Power Plant Unit 2	1,128,000	Pacific Gas & Electric Co	1982
*	Eastern Desert Plant Unit 1	770,000	Southern California Edison Co	1981
*	Eastern Desert Plant Unit 2	770,000	Southern California Edison Co.	1982
COLORADO				
Platteville	Ft. St. Vrain Nuclear Generating Station	330,000	Public Service Co. of Colorado	1973
CONNECTICUT				
Haddam Neck	Haddam Neck Plant	575,000	Conn. Yankee Atomic Power Co.	1968
Waterford	Millstone Nuclear Power Station Unit 1	652,100	Northeast Utilities	1971
Waterford	Millstone Nuclear Power Station Unit 2	828,000	Northeast Utilities	1974
Waterford	Millstone Nuclear Power Station Unit 3	1,150,000	Northeast Utilities	1979
DELAWARE				
Middletown	Delmarva Unit 1	770,000	Delmarva Power & Light Co	1979
Middletown	Delmarva Unit 2	770,000	Delmarva Power & Light Co	1982
FLORIDA				
Florida City	Turkey Point Station Unit 3	693,000	Florida Power & Light Co	1972
Florida City	Turkey Point Station Unit 4	693,000	Florida Power & Light Co	1973
Red Level	Crystal River Plant Unit 3	825,000	Florida Power Corp	1973
Ft. Pierce	St. Lucie Plant Unit 1	801,000	Florida Power & Light Co	1975
Ft. Pierce	St. Lucie Plant Unit 2	801,000	Florida Power & Light Co	1978
GEORGIA				
Baxley	Edwin I. Hatch Nuclear Plant Unit 1	786,000	Georgia Power Co	1974
Baxley	Edwin I. Hatch Nuclear Plant Unit 2	795,000	Georgia Power Co	1978
Waynesboro	Alvin W. Vogtle, Jr. Plant Unit 1	1,121,000	Georgia Power Co	1980
Waynesboro	Alvin W. Vogtle, Jr. Plant Unit 2	1,121,000	Georgia Power Co	1981
ILLINOIS				
Morris	Dresden Nuclear Power Station Unit 1	200,000	Commonwealth Edison Co	1960
Morris	Dresden Nuclear Power Station Unit 2	809,000	Commonwealth Edison Co.	1970
Morris	Dresden Nuclear Power Station Unit 3	809,000	Commonwealth Edison Co.	1971
Zion	Zion Nuclear Plant Unit 1	1,050,000	Commonwealth Edison Co.	1973
Zion	Zion Nuclear Plant Unit 2	1,050,000	Commonwealth Edison Co.	1974
Cordova	Quad Cities Station Unit 1	800,000	Comm. Ed. Co. Ia. Ill. Gas & Elec. Co	1972
Cordova	Quad Cities Station Unit 2	800,000	Comm. Ed. Co. Ia. Ill. Gas & Elec. Co	1972
Seneca	LaSalle Co. Nuclear Station Unit 1	1,078,000	Comm. Ed. Co. Ia	1977
Seneca	LaSalle Co. Nuclear Station Unit 2	1,078,000	Comm. Ed. Co. Ia	1978
Byron	Byron Station Unit 1	1,120,000	Comm. Edison Co	1979
Byron	Byron Station Unit 2	1,120,000	Comm. Edison Co	1980
Braidwood	Braidwood Unit 1	1,100,000	Comm. Edison Co	1979
Braidwood	Braidwood Unit 2	1,100,000	Comm. Edison Co	1980
Clinton	Clinton Nuclear Power Plant Unit 1	950,000	Illinois Power Co	1980
Clinton	Clinton Nuclear Power Plant Unit 2	950,000	Illinois Power Co	1982
INDIANA				
Dune Acres	Bailly Generating Station	660,000	Northern Indiana Public Service Co	1977
IOWA				
Palo	Duane Arnold Energy Center Unit 1	529,700	Iowa Electric Light and Power Co	1974
LOUISIANA				
Taft	Waterford Generating Station	1,113,000	Louisiana Power & Light Co	1977
St. Francisville	River Bend Station	934,000	Gulf States Utilities Co	1979

Figure 1. Nuclear power reactors in the United States, June 30, 1973—continued

SITE	PLANT NAME	CAPACITY (Net Kilowatts)	UTILITY	COMMERCIAL OPERATION
ALABAMA				
Decatur	Browns Ferry Nuclear Power Plant: Unit 1	1,065,000	Tennessee Valley Authority	1973
Decatur	Browns Ferry Nuclear Power Plant: Unit 2	1,065,000	Tennessee Valley Authority	1974
Decatur	Browns Ferry Nuclear Power Plant: Unit 3	1,065,000	Tennessee Valley Authority	1974
Dothan	Joseph M. Farley Nuclear Plant: Unit 1	829,000	Alabama Power Co.	1975
Dothan	Joseph M. Farley Nuclear Plant: Unit 2	829,000	Alabama Power Co.	1977
Orville	Central Alabama Nuclear Plant	1,100,000	Alabama Power Co.	1980
Orville	Central Alabama Nuclear Plant	1,100,000	Alabama Power Co.	1981
Scottsboro	Bellefonte Nuclear Plant: Unit 1	1,189,000	Tennessee Valley Authority	1979
Scottsboro	Bellefonte Nuclear Plant: Unit 2	1,189,000	Tennessee Valley Authority	1980
ARKANSAS				
Russellville	Arkansas Nuclear One: Unit 1	820,000	Arkansas Power & Light Co.	1973
Russellville	Arkansas Nuclear One: Unit 2	902,000	Arkansas Power & Light Co.	1976
CALIFORNIA				
Humboldt Bay	Humboldt Bay Power Plant: Unit 3	68,500	Pacific Gas and Electric Co.	1963
San Clemente	San Onofre Nuclear Generating Station: Unit 1	430,000	So. Calif. Ed. & San Diego Gas & El. Co.	1968
San Clemente	San Onofre Nuclear Generating Station: Unit 2	1,140,000	So. Calif. Ed. & San Diego Gas & El. Co.	1978
San Clemente	San Onofre Nuclear Generating Station: Unit 3	1,140,000	So. Calif. Ed. & San Diego Gas & El. Co.	1979
Diablo Canyon	Diablo Canyon Nuclear Power Plant: Unit 1	1,060,000	Pacific Gas and Electric Co.	1975
Diablo Canyon	Diablo Canyon Nuclear Power Plant: Unit 2	1,060,000	Pacific Gas and Electric Co.	1976
Clay Station	Rancho Seco Nuclear Generating Station	804,000	Sacramento Municipal Utility District	1974
Pt. Arena	Mendocino Power Plant: Unit 1	1,128,000	Pacific Gas & Electric Co.	1981
Pt. Arena	Mendocino Power Plant: Unit 2	1,128,000	Pacific Gas & Electric Co.	1982
*	Eastern Desert Plant: Unit 1	770,000	Southern California Edison Co.	1981
*	Eastern Desert Plant: Unit 2	770,000	Southern California Edison Co.	1982
COLORADO				
Platteville	Ft. St. Vrain Nuclear Generating Station	330,000	Public Service Co. of Colorado	1973
CONNECTICUT				
Haddam Neck	Haddam Neck Plant	575,000	Conn. Yankee Atomic Power Co.	1968
Waterford	Millstone Nuclear Power Station: Unit 1	652,100	Northeast Utilities	1971
Waterford	Millstone Nuclear Power Station: Unit 2	828,000	Northeast Utilities	1974
Waterford	Millstone Nuclear Power Station: Unit 3	1,150,000	Northeast Utilities	1979
DELAWARE				
Middletown	Delmarva Unit 1	770,000	Delmarva Power & Light Co.	1979
Middletown	Delmarva Unit 2	770,000	Delmarva Power & Light Co.	1982
FLORIDA				
Florida City	Turkey Point Station: Unit 3	693,000	Florida Power & Light Co.	1972
Florida City	Turkey Point Station: Unit 4	693,000	Florida Power & Light Co.	1973
Red Level	Crystal River Plant: Unit 3	825,000	Florida Power Corp.	1973
Ft. Pierce	St. Lucie Plant: Unit 1	801,000	Florida Power & Light Co.	1975
Ft. Pierce	St. Lucie Plant: Unit 2	801,000	Florida Power & Light Co.	1978
GEORGIA				
Baxley	Edwin I. Hatch Nuclear Plant: Unit 1	786,000	Georgia Power Co.	1974
Baxley	Edwin I. Hatch Nuclear Plant: Unit 2	795,000	Georgia Power Co.	1978
Waynesboro	Alvin W. Vogtle, Jr. Plant: Unit 1	1,121,000	Georgia Power Co.	1980
Waynesboro	Alvin W. Vogtle, Jr. Plant: Unit 2	1,121,000	Georgia Power Co.	1981
ILLINOIS				
Morris	Dresden Nuclear Power Station: Unit 1	200,000	Commonwealth Edison Co.	1960
Morris	Dresden Nuclear Power Station: Unit 2	809,000	Commonwealth Edison Co.	1970
Morris	Dresden Nuclear Power Station: Unit 3	809,000	Commonwealth Edison Co.	1971
Zion	Zion Nuclear Plant: Unit 1	1,050,000	Commonwealth Edison Co.	1973
Zion	Zion Nuclear Plant: Unit 2	1,050,000	Commonwealth Edison Co.	1974
Cordova	Quad Cities Station: Unit 1	800,000	Comm. Ed. Co. Ia. Ill. Gas & Elec. Co.	1972
Cordova	Quad Cities Station: Unit 2	800,000	Comm. Ed. Co. Ia. Ill. Gas & Elec. Co.	1972
Seneca	LaSalle Co. Nuclear Station: Unit 1	1,078,000	Comm. Ed. Co. Ia.	1977
Seneca	LaSalle Co. Nuclear Station: Unit 2	1,078,000	Comm. Ed. Co. Ia.	1978
Byron	Byron Station: Unit 1	1,120,000	Comm. Edison Co.	1979
Byron	Byron Station: Unit 2	1,120,000	Comm. Edison Co.	1980
Braidwood	Braidwood: Unit 1	1,100,000	Comm. Edison Co.	1979
Braidwood	Braidwood: Unit 2	1,100,000	Comm. Edison Co.	1980
Clinton	Clinton Nuclear Power Plant: Unit 1	950,000	Illinois Power Co.	1981
Clinton	Clinton Nuclear Power Plant: Unit 2	950,000	Illinois Power Co.	1982
INDIANA				
Dune Acres	Bailly Generating Station	660,000	Northern Indiana Public Service Co.	1977
IOWA				
Palo	Duane Arnold Energy Center: Unit 1	529,700	Iowa Electric Light and Power Co.	1974
LOUISIANA				
Taft	Waterford Generating Station	1,113,000	Louisiana Power & Light Co.	1977
St. Francisville	River Bend Station	934,000	Gulf States Utilities Co.	1979

Figure 1. Nuclear power reactors in the United States, June 30, 1973—continued

SITE	PLANT NAME	CAPACITY (Net Kilowatts)	UTILITY	COMMERCIAL OPERATION
MAINE				
Wiscasset	Maine Yankee Atomic Power Plant	790,000	Maine Yankee Atomic Power Co	1972
MARYLAND				
Lusby	Calvert Cliffs Nuclear Power Plant Unit 1	845,000	Baltimore Gas and Electric Co	1974
Lusby	Calvert Cliffs Nuclear Power Plant Unit 2	845,000	Baltimore Gas and Electric Co	1975
Douglas Point	Douglas Point Project Unit 1	1,178,000	Potomac Electric Power Co	1980
Douglas Point	Douglas Point Project Unit 2	1,178,000	Potomac Electric Power Co	1981
MASSACHUSETTS				
Rowe	Yankee Nuclear Power Station	175,000	Yankee Atomic Electric Co	1961
Plymouth	Pilgrim Station Unit 1	664,000	Boston Edison Co	1972
Plymouth	Pilgrim Station Unit 2	1,180,000	Boston Edison Co	1978
MICHIGAN				
Big Rock Point	Big Rock Point Nuclear Plant	70,300	Consumers Power Co	1965
South Haven	Palisades Nuclear Power Station	700,000	Consumers Power Co	1971
Lagoona Beach	Enrico Fermi Atomic Power Plant Unit 2	1,123,000	Detroit Edison Co	1976
Lagoona Beach	Enrico Fermi Atomic Power Plant Unit 3	1,125,000	Detroit Edison Co	1979
Bridgman	Donald C. Cook Plant Unit 1	1,060,000	Indiana & Michigan Electric Co	1974
Bridgman	Donald C. Cook Plant Unit 2	1,060,000	Indiana & Michigan Electric Co	1975
Midland	Midland Nuclear Power Plant Unit 1	492,000	Consumers Power Co.	1979
Midland	Midland Nuclear Power Plant Unit 2	818,000	Consumers Power Co.	1980
St. Clair County	Greenwood Unit 2	1,240,000	Detroit Edison Co	1980
St. Clair County	Greenwood Unit 3	1,240,000	Detroit Edison Co	1981
Quanicassee	Quanicassee Unit 1	1,150,000	Consumers Power Co	1981
Quanicassee	Quanicassee Unit 2	1,150,000	Consumers Power Co	1982
MINNESOTA				
Monticello	Monticello Nuclear Generating Plant	545,000	Northern States Power Co	1971
Red Wing	Prairie Island Nuclear Generating Plant Unit 1	530,000	Northern States Power Co	1973
Red Wing	Prairie Island Nuclear Generating Plant Unit 2	530,000	Northern States Power Co	1974
MISSISSIPPI				
Port Gibson	Grand Gulf Nuclear Station	1,290,000	Mississippi Power & Light Co.	1979
NEBRASKA				
Fort Calhoun	Ft. Calhoun Station Unit 1	457,400	Omaha Public Power District	1973
Brownville	Cooper Nuclear Station	778,000	Nebraska Public Power District and Iowa Power and Light Co.	1973
NEW HAMPSHIRE				
Seabrook		1,100,000	Public Service of N.H	1979
Seabrook		1,100,000	Public Service of N.H	1981
NEW JERSEY				
Toms River	Oyster Creek Nuclear Power Plant Unit 1	640,000	Jersey Central Power & Light Co	1969
Forked River	Forked River Generating Station Unit 1	1,070,000	Jersey Central Power & Light Co	1978
Salem	Salem Nuclear Generating Station Unit 1	1,090,000	Public Service Electric and Gas, N.J	1975
Salem	Salem Nuclear Generating Station Unit 2	1,115,000	Public Service Electric and Gas, N.J	1976
Bordentown	Newbold Nuclear Generating Station Unit 1	1,067,900	Public Service Electric and Gas, N.J	1979
Bordentown	Newbold Nuclear Generating Station Unit 2	1,067,000	Public Service Electric and Gas, N.J	1980
Little Egg Inlet	Atlantic Generating Station Unit 1	1,150,000	Public Service Electric and Gas, N.J	1980
Little Egg Inlet	Atlantic Generating Station Unit 2	1,150,000	Public Service Electric and Gas, N.J	1981
NEW YORK				
Indian Point	Indian Point Station Unit 1	265,000	Consolidated Edison Co	1962
Indian Point	Indian Point Station Unit 2	873,000	Consolidated Edison Co	1973
Indian Point	Indian Point Station Unit 3	965,000	Consolidated Edison Co	1974
Scriba	Nine Mile Point Nuclear Station Unit 1	625,000	Niagara Mohawk Power Co	1969
Scriba	Nine Mile Point Nuclear Station Unit 2	1,080,000	Niagara Mohawk Power Co	1978
Ontario	R.E. Ginna Nuclear Power Plant Unit 1	420,000	Rochester Gas & Electric Co	1970
Brookhaven	Shoreham Nuclear Power Station	819,000	Long Island Lighting Co.	1977
Scriba	James A. Fitzpatrick Nuclear Power Plant	821,000	Power Authority of State of N.Y	1973
.		1,150,000	Long Island Lighting Co.	1981
NORTH CAROLINA				
Southport	Brunswick Steam Electric Plant Unit 1	821,000	Carolina Power and Light Co	1975
Southport	Brunswick Steam Electric Plant Unit 2	821,000	Carolina Power and Light Co	1974
Cowans Ford Dam	Wm. B. McGuire Nuclear Station Unit 1	1,180,000	Duke Power Co	1976
Cowans Ford Dam	Wm. B. McGuire Nuclear Station Unit 2	1,180,000	Duke Power Co	1977
Bonsal	Shearon Harris Plant Unit 1	915,000	Carolina Power & Light Co.	1978
Bonsal	Shearon Harris Plant Unit 2	915,000	Carolina Power & Light Co	1979
Bonsal	Shearon Harris Plant Unit 3	915,000	Carolina Power & Light Co	1980
Bonsal	Shearon Harris Plant Unit 4	915,000	Carolina Power & Light Co.	1981
.		1,200,000	Duke Power Co	1981
.		1,200,000	Duke Power Co	1982
.		1,200,000	Duke Power Co	1983
.		1,200,000	Duke Power Co	1984
.		1,200,000	Duke Power Co	1985
.		1,200,000	Duke Power Co	1986

Figure 1. Nuclear power reactors in the United States, June 30, 1973—continued

SITE	PLANT NAME	CAPACITY (Net Kilowatts)	UTILITY	COMMERCIAL OPERATION
OHIO				
Oak Harbor	Davis Besse Nuclear Power Station	906,000	Toledo Edison Cleveland Electric Illuminating Co.	1975
Painesville	Perry Nuclear Power Plant: Unit 1	1,205,000	Cleveland Electric Illuminating Co.	1979
Painesville	Perry Nuclear Power Plant: Unit 2	1,205,000	Cleveland Electric Illuminating Co.	1980
Moscow	Wm. H. Zimmer Nuclear Power Station: Unit 1	810,000	Cincinnati Gas & Electric Co.	1977
OREGON				
Prescott	Trojan Nuclear Plant: Unit 1	1,130,000	Portland General Electric Co.	1975
Boardman	—	1,200,000	Portland General Electric Co.	1980
PENNSYLVANIA				
Peach Bottom	Peach Bottom Atomic Power Station: Unit 1	40,000	Philadelphia Electric Co.	1967
Peach Bottom	Peach Bottom Atomic Power Station: Unit 2	1,065,000	Philadelphia Electric Co.	1973
Peach Bottom	Peach Bottom Atomic Power Station: Unit 3	1,065,000	Philadelphia Electric Co.	1974
Pottstown	Limerick Generating Station: Unit 1	1,065,000	Philadelphia Electric Co.	1978
Pottstown	Limerick Generating Station: Unit 2	1,065,000	Philadelphia Electric Co.	1980
Shippingport	Shippingport Atomic Power Station: Unit 1	90,000	Duquesne Light Co.	1957
Shippingport	Beaver Valley Power Station: Unit 1	852,000	Duquesne Light Co. Ohio Edison Co.	1974
Shippingport	Beaver Valley Power Station: Unit 2	852,000	Duquesne Light Co. Ohio Edison Co.	1978
Goldsboro	Three Mile Island Nuclear Station: Unit 1	819,000	Metropolitan Edison Co.	1974
Goldsboro	Three Mile Island Nuclear Station: Unit 2	905,000	Jersey Central Power & Light Co.	1976
Berwick	Susquehanna Steam Electric Station: Unit 1	1,052,000	Pennsylvania Power and Light	1979
Berwick	Susquehanna Steam Electric Station: Unit 2	1,052,000	Pennsylvania Power and Light	1981
Fulton Township	Philadelphia Electric Co.: HTGR No. 1	1,140,000	Philadelphia Electric Co.	1981
Fulton Township	Philadelphia Electric Co.: HTGR No. 2	1,140,000	Philadelphia Electric Co.	1983
SOUTH CAROLINA				
Hartsville	H. B. Robinson S.E. Plant: Unit 2	700,000	Carolina Power & Light Co.	1971
Seneca	Oconee Nuclear Station: Unit 1	841,000	Duke Power Co.	1973
Seneca	Oconee Nuclear Station: Unit 2	886,000	Duke Power Co.	1973
Seneca	Oconee Nuclear Station: Unit 3	886,000	Duke Power Co.	1974
Broad River	Virg. C. Summer Nuclear Station: Unit 1	900,000	South Carolina Electric & Gas Co.	1977
Lake Wylie	Catawba Nuclear Station: Unit 1	1,180,000	Duke Power Co.	1979
Lake Wylie	Catawba Nuclear Station: Unit 2	1,180,000	Duke Power Co.	1980
TENNESSEE				
Daisy	Sequoyah Nuclear Power Plant: Unit 1	1,140,000	Tennessee Valley Authority	1975
Daisy	Sequoyah Nuclear Power Plant: Unit 2	1,140,000	Tennessee Valley Authority	1975
Spring City	Watts Bar Nuclear Plant: Unit 1	1,169,000	Tennessee Valley Authority	1977
Spring City	Watts Bar Nuclear Plant: Unit 2	1,169,000	Tennessee Valley Authority	1978
Oak Ridge	Fast Breeder Demonstration Plant	400,000	Tennessee Valley Authority	1980
TEXAS				
Glen Rose	Commanche Peak Steam Electric Station: Unit 1	1,150,000	Texas Utilities Services Inc.	1980
Glen Rose	Commanche Peak Steam Electric Station: Unit 2	1,150,000	Texas Utilities Services Inc.	1982
Newton County	Blue Hills: Unit 1	918,000	Gulf States Utilities	1980
VERMONT				
Vernon	Vermont Yankee Generating Station	513,900	Vermont Yankee Nuclear Power Corp.	1972
VIRGINIA				
Gravel Neck	Surry Power Station: Unit 1	788,000	Virginia Electric & Power Co.	1972
Gravel Neck	Surry Power Station: Unit 2	788,000	Virginia Electric & Power Co.	1973
Mineral	North Anna Power Station: Unit 1	898,000	Virginia Electric & Power Co.	1974
Mineral	North Anna Power Station: Unit 2	898,000	Virginia Electric & Power Co.	1975
Mineral	North Anna Power Station: Unit 3	907,000	Virginia Electric & Power Co.	1977
Mineral	North Anna Power Station: Unit 4	907,000	Virginia Electric & Power Co.	1978
Gravel Neck	Surry Power Station: Unit 3	882,000	Virginia Electric & Power Company	1980
Gravel Neck	Surry Power Station: Unit 4	882,000	Virginia Electric & Power Company	1981
WASHINGTON				
Richland	N Reactor WPPSS Steam	800,000	Atomic Energy Commission	1966
Richland	WPPSS No. 1	1,120,000	Washington Public Power Supply System	1980
Richland	WPPSS No. 2	1,103,000	Washington Public Power Supply System	1977
WISCONSIN				
Genoa	Genoa Nuclear Generating Station	53,200	Dairyland Power Cooperative	1971
Two Creeks	Point Beach Nuclear Plant: Unit 1	497,000	Wisconsin Michigan Power Co.	1970
Two Creeks	Point Beach Nuclear Plant: Unit 2	497,000	Wisconsin Michigan Power Co.	1972
Carlton	Kewaunee Nuclear Power Plant: Unit 1	541,000	Wisconsin Michigan Power Co.	1973
PUERTO RICO				
Puerto De Jobas	Aguirre Nuclear Power Plant	583,000	Puerto Rico Water Resources Authority	1979
*		1,128,000	Tennessee Valley Authority	1980
*		1,128,000	Tennessee Valley Authority	1981
*		1,128,000	Tennessee Valley Authority	1980
*		1,128,000	Tennessee Valley Authority	1981

* Site not selected.

Figure 1. Nuclear power reactors in the United States, June 30, 1973—continued

Reported Nuclear Detonations, August 1973

(Includes seismic signals presumably from foreign nuclear detonations)

Seismic signals, presumably from a Soviet underground nuclear explosion, were recorded by the United States on August 14, 1973. The signals originated at approximately 10:00 p.m. (EDT), in the southern part of the U.S.S.R. northwest of Tashkent, and were equivalent to those of an underground nuclear explosion in the yield range of 20–200 kilotons.

An August 27, 1973, the United States recorded seismic signals, presumably from a Soviet underground nuclear explosion. The signals originated from the northern Kazakh Desert and were equivalent to those of an underground nuclear explosion in the yield range of 20–200 kilotons.

There were no reported nuclear detonations for the United States for August 1973.

Not all of the nuclear detonations in the United States are announced immediately, therefore, the information in this section may not be complete. A complete list of announced U.S. nuclear detonations may be obtained upon request from the Division of Public Information, U.S. Atomic Energy Commission, Washington, D.C. 20545.

SYNOPSES

Synopses of reports, incorporating a list of key words, are furnished below in reference card format for the convenience of readers who may wish to clip them for their files.

ENVIRONMENTAL MONITORING AND DISPOSAL OF RADIOACTIVE WASTE FROM U.S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES, 1972. *M. E. Miles and G. L. Sjoblom. Radiation Data and Reports,* Vol. 14, September 1973, pp. 517–525.

The environmental effect of disposal of radioactive wastes originating from U.S. Naval nuclear propulsion plants and their support facilities is assessed. The total radioactivity discharged to all ports and harbors from the more than 100 nuclear-powered ships and supporting tenders, bases and shipyards was less than 0.002 curie in 1972. This report confirms that procedures used by the Navy to control releases of radioactivity from U.S. Naval nuclear-powered ships and their support facilities are effective in protecting the environment and the health and safety of the general public.

KEYWORDS: Discharges, disposal, harbors, monitoring, nuclear-powered ships, radioactivity, U.S. Naval, wastes.